CHAPTER 6
Vegetation
Preservation

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The Lake Tahoe Basin lies within a unique geologic basin in the Sierra Nevada. The Lake's elevation averages 6,225 feet, and surrounding peaks reach heights of up to 10,880 feet. Three vegetation zones occur within this range in elevation: Montane, Upper Montane, and Subalpine vegetation. A diversity of vegetation types is represented; for example, the most recent vegetation map of the Basin identified over 60 discrete types (TRPA 2007).

A total of 1,077 vascular plants have been confirmed to occur in the Basin with another 360 possibly occurring; in addition, the Basin is home to 115 species of non-vascular plants (USDA 2000). There are 11 special status plant species[1] documented in the Basin (seven vascular and four non-vascular) and an additional 19 special status plant species may occur but have not been documented. Tahoe yellow cress (*Rorippa subumbellata*) is the only plant listed as Endangered by California and Nevada. It is also a candidate for listing under the Federal Endangered Species Act.

The Lake Tahoe Basin supports many biologically rich emergent wetlands, fens/bogs, and riparian areas (USDA 2000). These areas have been identified as "plant communities of concern" and contribute substantially to the biological richness and productivity of the Region. Another plant community of concern is the deep-water plants of Lake Tahoe (TRPA 1982a).

The vegetation conditions and patterns in the Lake Tahoe Region today are a reflection of past and current human activities (USDA 2000; Taylor 2007). Prior to the early 1800s, the Washoe people occupied the Tahoe Basin. A combination of Washoe land use practices and natural processes maintained a diversity of forest types (USDA 2000). Logging activities began in 1859, and within 40 years about 60 percent of the Tahoe watershed had been clear-cut (USDA 2000). The remaining unlogged land was generally alpine, barren, or inaccessible (USDA 2000). As a result, most forestlands of the Basin are less than 150 years old, with few examples of young and very old forest stands (USDA 2000). After most of the logging was complete, federal and state governments began acquiring lands in 1899, and intensified acquisition in the 1930s. The vegetation that has developed on the landscape in the past 100 to 150 years received little active management except fire suppression until the late 1970s when forest management treatments began. As a result, much of the forestland is even-aged

[1] *Special status species are generally thought of as having low abundance, limited distributions, or small population sizes. Special status plant species are identified through an evaluation of multiple parameters that may include any or all of the following criteria:*

- *Rarity or limited distribution throughout the species' range or the region*
- *Endemism (species endemic to the Basin are found only within the Basin and nowhere else)*
- *Presence of threats and perceived vulnerability to local extirpation or extinction*

and densely stocked (Beaty and Taylor 2008). Vegetation types that depend on frequent fire to maintain them (e.g., Jeffrey pine) are gradually being replaced by species less dependent on fire (e.g., white fir) (Taylor 2007). The long history of fire suppression, combined with periods of drought and insect-induced mortality, has resulted in stands with high concentrations of hazardous fuels (USDA 2000; Raumann and Cablk 2008). This condition increased the threat of catastrophic wildfire and is typical of a forest where natural disturbance processes have been excluded. Since the 2007 Angora Fire in South Lake Tahoe, several land management agencies have intensified fuel reduction treatments in conifer forests in the Region, especially in areas surrounding urban development (D. Fournier, personal communication, 2011).

Housing, commercial, and infrastructure construction has also influenced today's vegetation patterns. Not only has vegetative cover been removed, but the composition of remaining vegetation has been changed through landscaping as well. These changes in cover and composition have potentially resulted in increased erosion and nutrient runoff from developed lots and the introduction of non-native species into the Basin.

Since 1900, about 75 percent of the marshlands and 50 percent of the meadows in the Basin have been disturbed or lost to urban development (USDA 1988; USDA 2000). Consequently, the conservation of the remaining wetland and riparian vegetation types is critical. Most special status plant species in the Basin occur on public lands, and therefore they have been afforded adequate protection to date.

Today, approximately 85 percent of the land in the Basin is managed by the U.S. Forest Service, Nevada Division of State Lands, the California Department of Parks and Recreation, and the California Tahoe Conservancy. The majority of the remaining 15 percent is privately owned, with a small percentage owned by local districts and governments. Because of the high percentage of public ownership there is great potential for conserving and restoring the health and diversity of plant communities in the Lake Tahoe Basin. However, responsible stewardship and management of vegetation resources on private lands remains key to the sustainability of these lands.

Prior to the adoption of Threshold Standards, TRPA developed two value statements related to vegetation conservation and management in the Basin: (1) Provide for a wide mix and increased diversity of plant communities in the Tahoe Basin, including such unique ecosystems as wetlands, meadows, and other riparian vegetation; and (2) conserve threatened, endangered, and sensitive plant species and uncommon plant communities of the Lake Tahoe Basin. These values guided the development of the vegetation Threshold Standards and remain as important values today.

In 1982, TRPA adopted several Threshold Standards related to three Indicator Reporting Categories including Common Vegetation, Uncommon Plant Communities, and Sensitive Plants (Resolution 82-11). Threshold Standards for the Late Seral and Old Growth Forest Ecosystems Indicator Reporting Category were adopted in 2001 in response to the U.S. Forest Service - Sierra Nevada Forest Plan Amendment.[2] Threshold Standards and associated indicators used to measure the progress toward meeting the Threshold Standards are presented in Table 6-1.

[2] USDA Forest Service, Pacific Southwest Region. 2001. Sierra Nevada Forest Plan Amendment, Final Environmental Impact Statement.

Table 6-1: *Summary of Vegetation Indicator Reporting Categories, adopted TRPA Threshold Standards by type, and indicators used to assess adopted standards.*

Indicator Reporting Category	Standard	Type of Standard	Indicator
Common Vegetation	• Maintain the existing species richness of the Basin by providing for the perpetuation of the following plant associations [9 vegetation associations]: • **Yellow Pine Forest**: Jeffrey pine, white fir, incense cedar, sugar pine. • **Red Fir Forest**: red fir, Jeffrey pine, lodgepole pine, western white pine, mountain hemlock, western juniper. • **Subalpine Forest**: whitebark pine, mountain hemlock, mountain mahogany. • **Shrub Association**: greenleaf and pinemat manzanita, tobacco brush, Sierra chinquapin, huckleberry oak, mountain whitethorn. • **Sagebrush Scrub Vegetation**: basin sagebrush, bitterbrush, Douglas chaenactis. • **Deciduous Riparian**: quaking aspen, mountain alder, black cottonwood, willow. • **Meadow Associations (Wet and Dry Meadow):** mountain squirrel tail, alpine gentian, whorled penstemon, asters, fescues, mountain brome, corn lilies, mountain bentgrass, hairgrass, marsh marigold, elephant heads, tinker's penney, mountain timothy, sedges, rushes, buttercups. • **Wetland Associations (Marsh Vegetation):** pond lilies, buckbean, mare's tail, pondweed, common bladderwort, bottle sedge, common spikerush. • **Cushion Plant Association (Alpine Scrub):** alpine phlox, dwarf ragwort, draba.	Management Standard (w/ numeric target)	Species Richness (Number of Major Vegetation Associations)

Indicator Reporting Category	Standard	Type of Standard	Indicator
	Relative Abundance - Of the total amount of undisturbed vegetation in the Tahoe Basin: 1. Maintain at least 4% meadow and wetland vegetation. 2. Maintain at least 4% deciduous riparian vegetation. 3. Maintain no more than 25% dominant shrub association vegetation. 4. Maintain 15-25% of the Yellow Pine Forest in seral stages other than mature. 5. Maintain 15-25% of the Red Fir Forest in seral stages other than mature.	Management Standard (w/ numeric targets)	Relative Abundance (Percent Occurrence of Each Association)
	Provide for the proper juxtaposition of vegetation communities and age classes by: 1. Limiting acreage size of new forest openings to no more than eight acres. 2. Adjacent openings shall not be of the same relative age class or succession stage to avoid uniformity in stand composition and age.	Management Standard	Evidence of TRPA actions that support the Management Standard
Common Vegetation	A non-degradation standard to preserve plant communities shall apply to native deciduous trees, wetlands, and meadows while providing for opportunities to increase the acreage of such riparian associations to be consistent with the SEZ threshold.	Management Standard	Evidence of TRPA actions that support the Management Standard
	Native vegetation shall be maintained at a maximum level to be consistent with the limits defined in the Land Capability Classification of the Lake Tahoe Basin, California-Nevada, A Guide for Planning, Bailey, 1974, for allowable impervious cover and permanent site disturbance.	Management Standard	Evidence of TRPA actions that support the Management Standard
	It shall be a policy of the TRPA Governing Board that a non-degradation standard shall permit appropriate management practices.	Policy Statement	Evidence of TRPA support for policy
Uncommon Plant Communities	Provide for the non-degradation of the natural qualities of any plant community that is uncommon to the Basin or of exceptional scientific, ecological, or scenic value. This threshold shall apply but not be limited to 1) the deep-water plants of Lake Tahoe, 2) Grass Lake (sphagnum fen), 3) Osgood Swamp, 4) the Freel Peak Cushion Plant Community, 5) Hell Hole (sphagnum fen), 6) Upper Truckee Marsh, 7) Taylor Creek Marsh, and 8) Pope Marsh.	Numerical Standard (without numeric targets)	The natural qualities of the community (*as determined by a qualified expert*).

Indicator Reporting Category	Standard	Type of Standard	Indicator
Sensitive Plants	Maintain a minimum number of population sites for each of five sensitive plant species. The minimum number of population sites is as follows: • *Arabis rigidissima* var. *demota* – Galena Creek rockcress (7) • *Draba asterophora* var. *asterophora* – Tahoe draba (5) • *Draba asterophora* var. *macrocarpa* – Cup Lake draba (2) • *Lewisia pygmaea longipetala* – Long-petaled lewisia (2) • *Rorippa subumbellata* – Tahoe yellow cress (26)	Numerical Standard	The number of population sites that are maintained as suitable habitat for sensitive plant species (*as determined by a qualified expert*).
Late Seral/ Old growth Ecosystems	Attain and maintain a minimum percentage of 55% by area of forested lands within the Tahoe Region (excluding TRPA designated urban areas) in a late seral or old growth condition, and distributed across elevation zones. To achieve the 55%, the elevation zones shall contribute as follows: • The Sub-alpine zone (greater than 8,500 feet elevation) will contribute 5% (7,600 acres) of the late seral acres (61% of the Subalpine zone must be in a late seral or old growth condition); • The Upper Montane zone (between 7,000 and 8,500 feet elevation) will contribute 30% (45,900 acres) of the late seral acres (60% of the Upper Montane zone must be in a late seral or old growth condition); • The Montane zone (lower than 7,000 feet elevation) will contribute 20% (30,600 acres) of the late seral acres (48% of the Montane zone must be in a late seral or old growth condition).	Numerical Standard	Percent of Subalpine, Upper Montane and Montane zone stand acres that are dominated by late seral or old growth characteristics (tree size >24" dbh)

Common Vegetation

Common vegetation comprises a major component of Lake Tahoe's landscape and is critical to supporting a number of other values appreciated by residents and visitors to the Region. The Common Vegetation Indicator Reporting Category primarily addresses the types of vegetation that most people experience, including shrubs, conifer forests, deciduous riparian hardwoods, meadows, and wetlands. Each of these major categories of vegetation contributes to the species richness of the Region. Factors that influence distribution and extent of common vegetation include forest management, urban development, past land use, natural disturbance (e.g., wildfire), competition with invasive and introduced species, climate, soils, aspect, elevation, and disease.

Regional Plan policy and management actions aimed at conserving common vegetation focus on maintaining the diversity of native vegetation, implementing appropriate forest management techniques and technologies, and restoring and protecting the relatively rare vegetation types (e.g., meadow and wetlands, old forest ecosystems).

The status and trends of six indicators related to Management Standards with numeric targets were evaluated to characterize the overall status and trend of the Common Vegetation Indicator Reporting Category. The six indicators include (1) vegetation community species richness, (2) immature red fir forests, (3) immature yellow pine forests, (4) deciduous riparian hardwoods, (5) meadows and wetlands, and (6) shrubs. In general, indicators for each of the Threshold Standards for Common Vegetation showed that the status is somewhat worse than adopted management targets; the overall trend shows that five of the six indicators are unknown, with little or no change in vegetation community richness. Overall confidence in the determination of status and trend was determined to be low (Figure 6-1), primarily due to differences in vegetation mapping approaches over time. The evaluation of two Common Vegetation Management Standards without numerical targets, and one Common Vegetation Policy Statement, indicated TRPA and other agencies have implemented policies, regulations and/or management actions consistent with the adopted Threshold Standards for Common Vegetation.

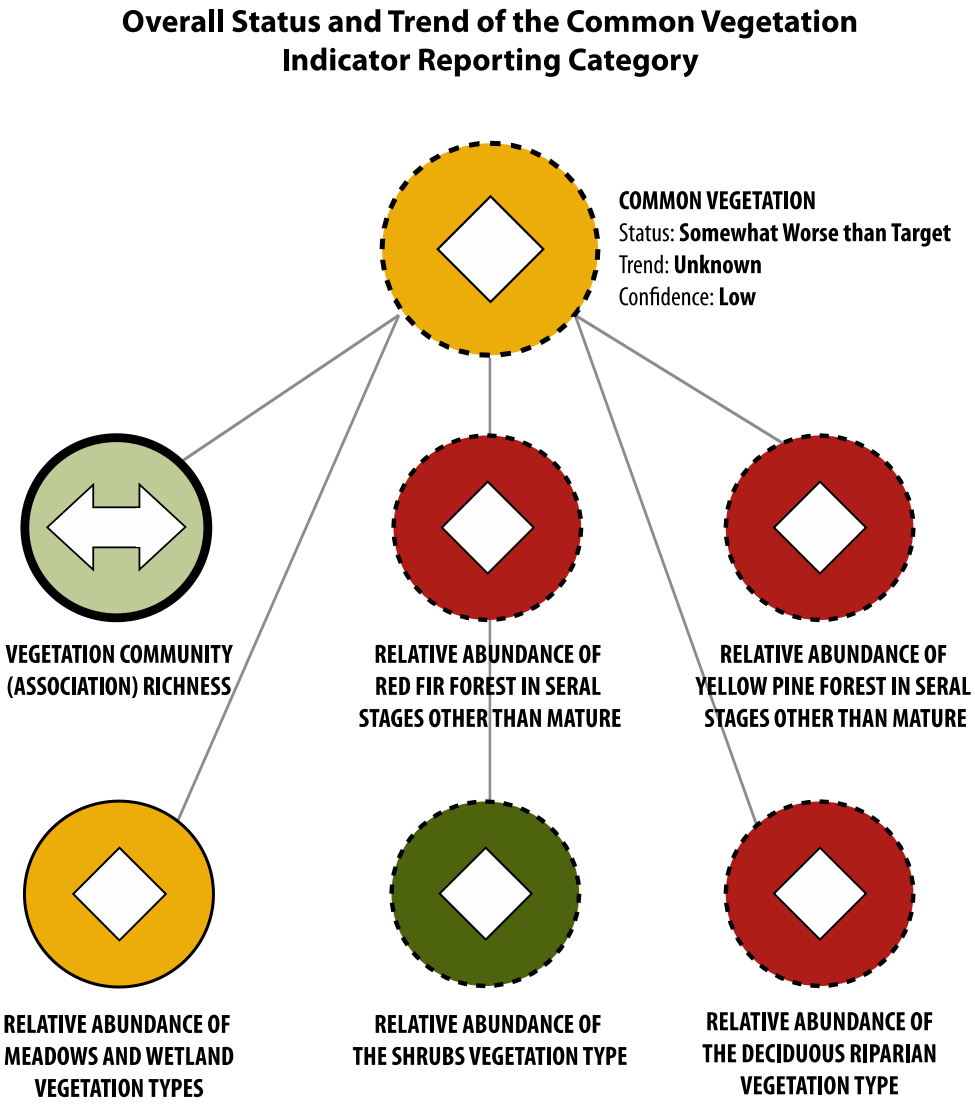
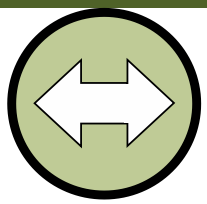


Figure 6-1. *Reporting icons for the six indicators evaluated in the Common Vegetation Indicator Reporting Category. Results from each of the six indicators (bottom) were evaluated and aggregated to characterize the overall status of the Common Vegetation Indicator Reporting Category (top).*

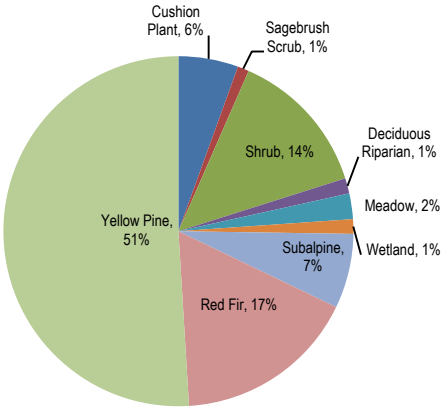
Common Vegetation: **Vegetation Community (Association) Richness**

Reporting Icon



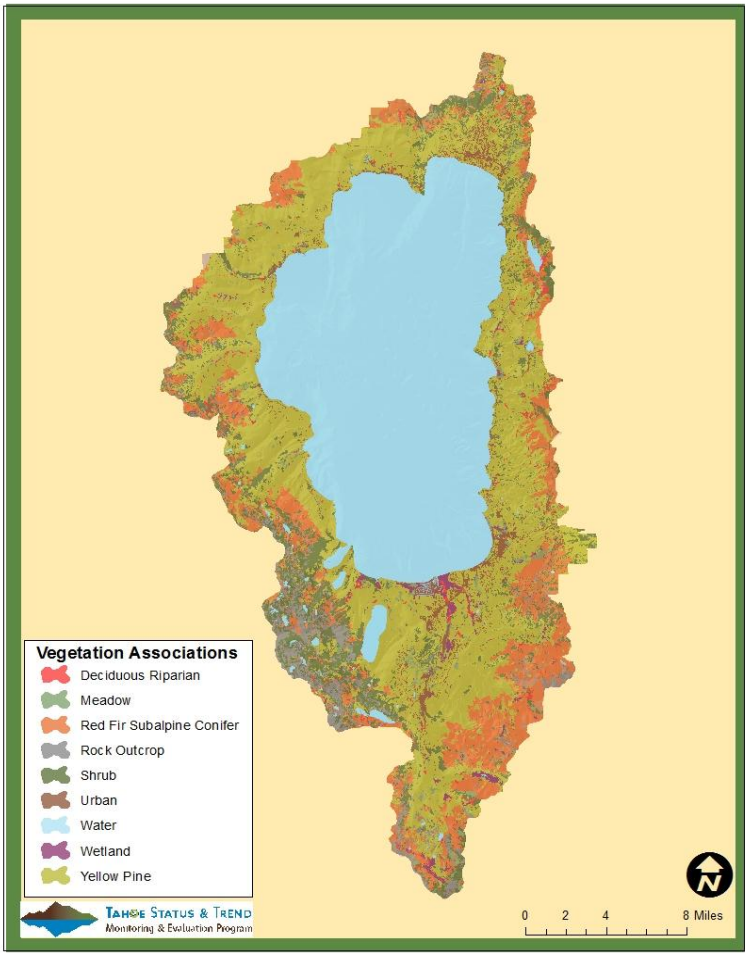
VEGETATION COMMUNITY RICHNESS
Status: **At or Somewhat Better than Target**
Trend: **Little or No Change**
Confidence: **High**

Graph



Estimated proportion of land covered by different TRPA vegetation communities (associations) in the Lake Tahoe Basin (USDA 2009c).

Map



Map showing the distribution and extent of major vegetation communities (associations) in the Lake Tahoe Basin (pre-Angora Fire of 2007). Source: U.S. Forest Service - Pacific Southwest Region, Remote Sensing Lab.

Data Evaluation and Interpretation

Relevance – This indicator measures the number (richness) and persistence of major native vegetation communities (associations) throughout the Lake Tahoe Basin. It is not a measure of plant species richness. This measure can be used to indicate whether a major vegetation community has been lost in the Region. The vegetation community richness indicator in combination with measures of vegetation community aerial extent (acreage) and structure could provide a measure of overall vegetation community diversity.

Threshold Category – Vegetation

Indicator Reporting Category – Common Vegetation

Adopted Standards – Maintain the existing species richness of the Basin by providing for the perpetuation of the following plant associations (nine communities):

- Yellow Pine Forest: Jeffrey pine, white fir, incense cedar, sugar pine
- Red Fir Forest: red fir, Jeffrey pine, lodgepole pine, western white pine, mountain hemlock, western juniper
- Subalpine Forest: whitebark pine, mountain hemlock, mountain mahogany
- Shrub Association: greenleaf and pinemat manzanita, tobacco brush, Sierra chinquapin, huckleberry oak, mountain whitethorn

- Sagebrush Scrub Vegetation: basin sagebrush, bitterbrush, Douglas chaenactis
- Deciduous Riparian: quaking aspen, mountain alder, black cottonwood, willow
- Meadow Associations (Wet and Dry Meadow): mountain squirrel tail, alpine gentian, whorled penstemon, asters, fescues, mountain brome, corn lilies, mountain bentgrass, hairgrass, marsh marigold, elephant heads, tinker's penney, mountain timothy, sedges, rushes, buttercups
- Wetland Associations (Marsh Vegetation): pond lilies, buckbean, mare's tail, pondweed, common bladderwort, bottle sedge, common spikerush
- Cushion Plant Association (Alpine Scrub): alpine phlox, dwarf ragwort, draba

Type of Standard – Management Standard with numeric target (maintain 9 major vegetation associations)

Indicator (Unit of Measure) – Number of vegetation associations. For this assessment, TRPA vegetation associations were compared with California Wildlife Habitat Relationship (CWHR 2011) Types (attributed in TMU_Strata_07 map, USFS 2009c) to determine which types could be considered equivalent. Using the following crosswalk table, CWHR types were used to estimate relative proportions of TRPA vegetation associations in the Tahoe Basin:

TRPA Association	California Wildlife Habitat Relationship Type
Cushion Plant	Barren
Deciduous Riparian	Aspen
Deciduous Riparian	Mixed Hardwood-Conifer
Deciduous Riparian	Montane Riparian
Meadow	Perennial Grass
Red Fir Forest	Juniper
Red Fir Forest	Lodgepole Pine
Red Fir Forest	Red Fir
Sagebrush Scrub	Bitterbrush
Sagebrush Scrub	Low Sagebrush
Sagebrush Scrub	Sagebrush
Shrub	Alpine Dwarf Shrub
Shrub	Montane Chaparral
Subalpine Forest	Subalpine Conifer
Wetland	Wet Meadow
Yellow Pine Forest	Eastside Pine
Yellow Pine Forest	Jeffrey Pine
Yellow Pine Forest	Sierran Mixed Conifer
Yellow Pine Forest	White Fir

Status – Vegetation community richness in the Basin has been maintained. All of the major vegetation associations that were identified in the *Regional Plan* (1987 as amended in 2012) and U.S. Forest Service – LTBMU Forest Plan (1988) persist today and are not in immediate danger of being lost as a result of in-basin management activities. Locations of individual vegetation communities are expected to shift over time as a result of natural disturbances such as wildfire, though community richness is expected to persist through successional processes.

Trend – Although there has been fluctuation in the aerial extent of some vegetation communities in the Lake Tahoe Basin (Raumann and Cablk 2008), there has been no loss or gain in the total number of native vegetation communities. Consequently, it was determined that there was "little or no change" in trend for the vegetation community richness indicator.

Confidence – There was "high" confidence in both the status and trend for this indicator. Forest managers use best available technology and field reconnaissance to map and classify vegetation types throughout the Lake Tahoe Basin about every five years; U.S. Forest Service vegetation mapping procedures meet regional and national vegetation mapping standards (Warbington [No Date]; FGDC 1997). Because vegetation communities are broadly defined and thus encompass larger spatial extents than individual habitat types, variation in the status and trend of the vegetation community richness indicator is not obvious at the relatively short time scales for which the indicator is remapped and reassessed. The accuracy assessment of TMU_Strata_07 map used for this summary was conducted by the U.S. Forest Service, Pacific Southwest Region - Remote Sensing Lab.

Interim Target – The Region was determined to be in attainment with the adopted Threshold Standard, and therefore it is not necessary to identify an interim target.

Target Attainment Date – The Region was determined to be in attainment with the adopted Threshold Standard, and therefore it is not necessary to identify a target attainment date.

Human & Environmental Drivers – Climate, elevation, soils, aspect, geomorphology, interspecies competition, and wildlife are

natural influences on pattern and expression of vegetation communities in the Lake Tahoe Basin. Fire suppression (lack of fire), and natural and human caused wildfire can also influence the distribution and extent of different vegetation communities. For example, the montane chaparral vegetation type has been decreasing in aerial extent by about 10% per decade due to fire suppression (Nagel and Taylor 2005). However, the recent Gondola (2002) and Angora fires (2007) created hundreds to thousands of acres of early successional vegetation that over time will likely be mostly comprised of shrub vegetation. Forest treatments designed to remove biomass can also influence vegetation communities. Treated areas in the Yellow Pine Forest have been shown to support higher intra-community plant species richness than in neighboring untreated forest (Safford et al. 2010); although this Indicator Category is not a direct measure of plant species richness, fostering intra-community species richness can potentially lead to future vegetation community richness. Trampling associated with unmanaged recreation can degrade rare high elevation plant communities, such as the cushion plant community.

Monitoring Approach – Satellite imagery, aerial photographs and field reconnaissance (Forest Inventory and Analysis) are used to delineate and classify vegetation types in the Lake Tahoe Basin. This information is digitized into a Geographic Information System (GIS) and subsequently analyzed to summarize vegetation community richness.

Monitoring Partners – U.S. Forest Service – Lake Tahoe Basin Management Unit and Pacific Southwest Remote Sensing Lab, TRPA

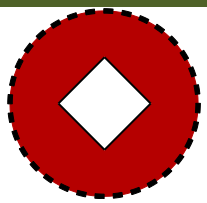
Programs and Actions Implemented to Improve Conditions – Policies and ordinances for the conservation of Tahoe's native vegetation communities have been adopted in the *Regional Plan* and are implemented through the permitting process. The Environmental Improvement Program (EIP) has and is currently implementing a fuels reduction and ecosystem restoration program. To date more than 45,000 acres of forest treatments have been completed in support of sustaining native vegetation communities. Treatments primarily include understory tree removal, biomass mastication, prescribed broadcast burning, and pile burning.

Effectiveness of Programs and Actions – Qualitative observations suggest current regulations, programs, forest fuels treatments and isolated events (e.g., Gondola [2002] and Angora [2007] Fires) all appear to have contributed to the maintenance of vegetation community richness in the Tahoe Region.

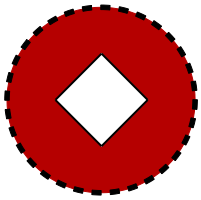
Recommendations for Additional Actions – Consideration should be given to amending the current Threshold Standard to incorporate best available science. The indicator does not lend itself well to helping managers understand the influence of human activity due to the relatively long timeframe that it would take for a vegetation community to fade out. However, the indicator does have the potential to inform managers of the effect of climate change on major vegetation communities over the long-term.

Common Vegetation: **Relative Abundance of Yellow Pine and Red Fir Forest in Seral Stages other than Mature**

Status

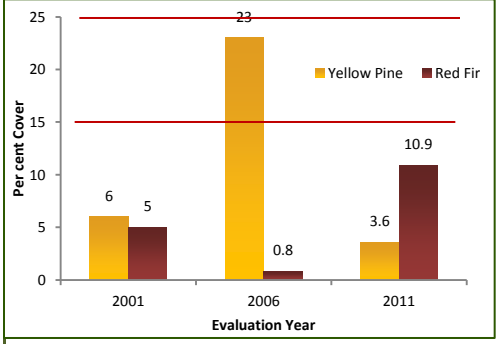


Relative Abundance of Yellow Pine Forest in Seral Stages other than Mature
Status: **Considerably Worse than Target**
Trend: **Unknown**
Confidence: **Low**



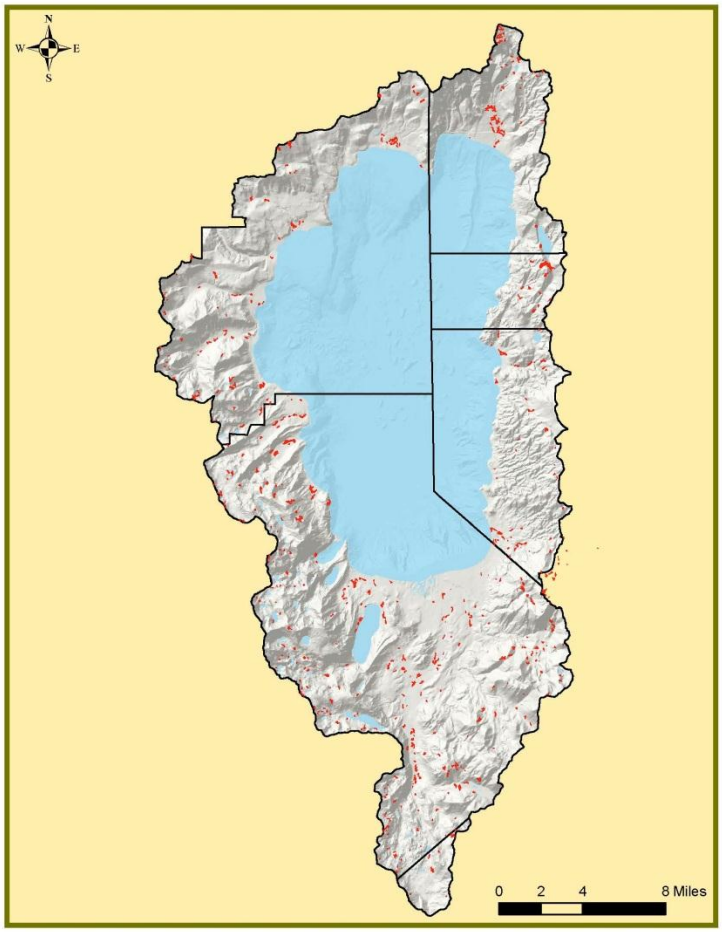
Relative Abundance of Red Fir Forest in Seral Stages other than Mature
Status: **Considerably Worse than Target**
Trend: **Unknown**
Confidence: **Low**

Trend



Estimated percent cover of small diameter tree size-classes (<20"dbh in 2001 and 2006; <10.9" dbh in 2011) for Yellow Pine and Red Fir Forests in the Lake Tahoe Basin by evaluation year (TRPA 2001; TRPA 2007c; USDA 2009c) relative to adopted management target (the range within red lines, 15 to 25%). Differences In percent cover were attributed to different evaluation criteria across evaluations.

Map



Geographic distribution of small diameter (< 10.9" dbh) Yellow Pine and Red Fir Forests (red areas in figure) in the Lake Tahoe Basin (USDA 2009c). Note: source data precedes 2007 Angora Fire.

Data Evaluation and Interpretation

Relevance – This indicator measures the relative proportion of tree stands classified in seral stages other than mature for Yellow Pine and Red Fir Forests in the Lake Tahoe Region. For this evaluation, "seral stages other than mature" was equated with stands dominated by small diameter trees (<10.9" dbh). The relative abundance of small-tree dominated stands is important because it provides a measure of forest sustainability; without young trees, Tahoe's forests will not be sufficiently stocked to replace dead and dying trees over time. Today, Tahoe's forests are dominated by an intermediate age/size class (ranging in diameter from 11" to 23"), due to past Comstock-era logging and ongoing fire suppression (Taylor 2007; USDA 2000; Raumann and Cablk 2008).

Threshold Category – Vegetation

Indicator Reporting Category – Common Vegetation

Adopted Standards – (Relative Abundance) Of the total amount of undisturbed vegetation in the Tahoe Basin - 1) Maintain 15-25% of the Yellow Pine Forest in seral stages other than mature. 2) Maintain 15-25% of the Red Fir Forest in seral stages other than mature.

Type of Standard – Management Standard with numeric targets

Indicator (Unit of Measure) – Relative proportion of tree stands dominated by small diameter trees (<10.9" dbh) for Yellow Pine and Red Fir Forests (percent [%])

Status – Based on the most current vegetation distribution data, the Region was determined not to be in attainment with Management Standards adopted for "seral stages other than mature" (interpreted for this evaluation as stands dominated by small diameter trees [<10.9"]) for both Yellow Pine and Red Fir Forests. The current percentage of small diameter (<10.9" dbh) Yellow Pine Forest cover is 3.6% (or 24% of the low end of the target); an estimated additional 11,570 acres of small diameter Yellow Pine Forest is needed to achieve the lower limits of this Management Standard. The current percentage of small diameter Red Fir Forest is 10.9% (or 72% of the low end of the target); an estimated additional 1,380 acres of small diameter Red Fir Forest is needed to achieve the lower limits of this management target. Past evaluations indicate that the Region was not meeting numeric targets, with the exception of Yellow Pine Forest documented in the 2006 TRPA Threshold Evaluation.

Trend – Earlier forest vegetation evaluations used lower resolution vegetation mapping approaches, and evaluation procedures were not sufficiently documented in the past. Most importantly, the 2006 evaluation used a diameter limit of <20" dbh to represent "small trees," while this evaluation uses a diameter limit of <10.9" dbh to represent "small trees," based on current interpretations of why the Threshold Standard was created. Thus, comparison of trend determinations among years is inappropriate and uncertain, so the trend determination for both small diameter Red Fir and Yellow Pine Forests was determined to be "unknown" because of insufficient data. The apparent improvement in the percentage of Red Fir Forest is most likely due to improvements in mapping and the change in diameter limit for "small trees" than to real ecosystem change. Areas affected by the Angora Fire (2007) and Gondola Fire (2002) are likely to eventually contribute about 3,800 acres of forestland occupied by first shrub, and then small diameter trees; however, these changes could take decades.

Confidence

Status – Vegetation data presented here met U.S. Forest Service mapping standards (Warbington et al. [no date]; FGDC 1997). Calculated overall accuracy of the map layer used for this evaluation was 70% confident that the vegetation characteristics represented on maps is similarly situated on the landscape (USDA 2009c). This level of accuracy equates to a "moderate" confidence determination for status.

Trends – Due to differences in mapping resolution and evaluation methodologies across years, a trend determination was not presented and consequently confidence in trend was determined to be "low."

Overall Confidence – Because there is low confidence in trend, a "low" confidence determination is assigned to the overall status and trend determination.

Interim Target – Current trend information is insufficient to estimate an interim target date for the Yellow Pine and Red Fir Forest Indicators. However, if land management agencies implement harvest and regeneration strategies that promote young age classes, such as group selections, it is possible that the percentage of small-diameter Red Fir and Yellow Pine cover will be maintained or will slightly increase in the Region by the next evaluation (2016).

Target Attainment Date – Current trend information is insufficient to estimate an attainment target date for both Yellow Pine and Red Fir Forest Indicators. Accomplishment of these Management Standards is largely dependent upon natural events such as stand-replacing wildfires that promote regeneration of small trees, funding for forest treatments, and forest managers' willingness to incorporate group selection type prescriptions into forest treatments – where trees are removed in small groups in order to encourage shade-intolerant species, such as pine, to seed and regenerate, ultimately resulting in a new age class.

Human & Environmental Drivers – The primary natural driver in creating patches of small diameter trees in the Lake Tahoe Basin is wildfire and other natural disturbances such as avalanche and wind-throw. Contemporary forest management practices do not substantially contribute to the creation of small diameter patches because the focus is to reduce understory ladder fuel loads (D. Fournier, personal communication, 2011).

Monitoring Approach – Every five years, the Tahoe vegetation map is updated with new satellite data (if available) and/or modeled and calibrated using field-based Forest Inventory and Analysis (FIA) data to assess the extent of different vegetation types and associated forest structure characteristics for the Basin (USDA 2009c; Warbington et al. [no date]). For this evaluation, stands dominated by trees <10.9" were enumerated from the following California Wildlife Habitat Relationship (CWHR 2011) Types attributed in the U.S. Forest Service - Remote Sensing Lab Pacific Southwest Region TMU_Strata_07 map layer (published 2009).

TRPA Association	California Wildlife Habitat Relationships Type	California Wildlife Habitat Relationships Size Class
Red Fir Forest	Red Fir	1"-5.9" and 6"-10.9"
Yellow Pine Forest	Eastside Pine	1"-5.9" and 6"-10.9"
Yellow Pine Forest	Jeffrey Pine	1"-5.9" and 6"-10.9"
Yellow Pine Forest	Sierran Mixed Conifer	1"-5.9" and 6"-10.9"
Yellow Pine Forest	White Fir	1"-5.9" and 6"-10.9"

Monitoring Partners – U.S. Forest Service, US Geological Survey and Tahoe Regional Planning Agency

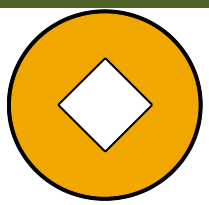
Programs and Actions Implemented to Improve Conditions – The *Code of Ordinances* allows for the creation of forest openings of up to 8 acres to facilitate the achievement of adopted Management Standards.

Effectiveness of Programs and Actions – Recently implemented fuels reduction treatments typically do not include prescriptions that include the creation of openings that would contribute to the achievement and maintenance of this Management Standard.

Recommendations for Additional Actions – The 2006 Threshold Evaluation noted difficulty in interpreting and evaluating the standard for Red Fir and Yellow Pine Forests in Seral Stages other than mature because the terminology used in the adopted standard is ambiguous. In this evaluation, an attempt was made to interpret the intent of the "other than mature" terminology to mean trees <10.9" dbh. Based on this interpretation and current information, the Region is not meeting numeric targets, and current forest treatments do not purposefully incorporate overstory tree removal treatments (i.e., small opening single tree selection or group selection harvest) that would facilitate openings needed to aid in achieving adopted Management Standards. Consequently, it is recommended that land managers purposefully prescribe group selections consistent within the limits of existing regulations in appropriate areas. In addition, due to low confidence assigned to the status and trend determination for these indicators, it is recommended that the Threshold Standard be amended to clarify terminology of "other than mature" and that a monitoring and evaluation plan currently under pilot testing be used to standardize and guide the evaluation of common vegetation indicators.

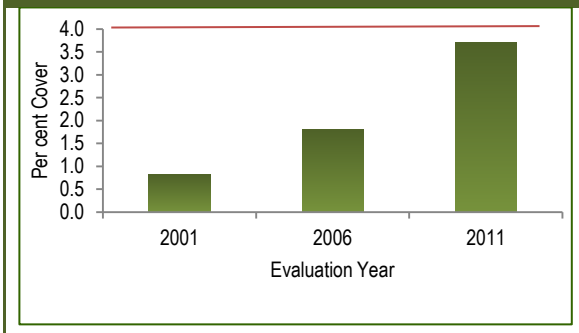
Common Vegetation: **Relative Abundance of Meadows and Wetland Vegetation Types**

Status & Trend



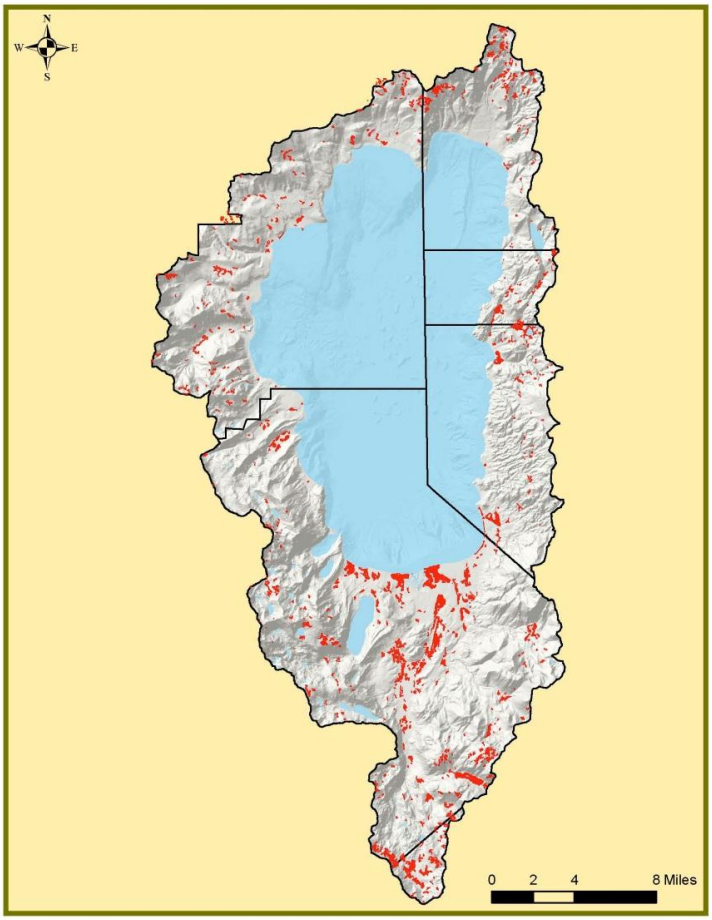
Relative Abundance of Meadows and Wetland Vegetation Types
Status: **Somewhat Worse than Target**
Trend: **Unknown**
Confidence: **Moderate**

Trend



Estimated percent of land area occupied by meadow and wetland vegetation in the Lake Tahoe Basin relative to TRPA adopted numeric target (red line). Sources: TRPA 2001; TRPA 2007c; USDA 2009c.

Map



Distribution and extent of the meadow and wetland vegetation types (red areas in figure) in the Lake Tahoe Basin (USDA 2009c).

Data Evaluation and Interpretation

Relevance –This indicator measures the proportion of land cover dominated by meadow (wet and dry variants) and wetland vegetation in the Tahoe Basin. The relative proportion of meadows and wetlands is important because the areas provide for a number of ecosystem services including flood attenuation, wildlife habitat diversity, ground water recharge, water filtration, and aesthetic and recreation values. According to USDA (2000), about 75% of the freshwater marshes and 50% of the meadows have been disturbed or developed since 1860. This indicator does not measure the relative condition of meadows and wetlands or their ability to support various ecosystem services or attributes.

Threshold Category – Vegetation

Indicator Category – Common Vegetation

Adopted Standards – (Relative Abundance) Of the total amount of undisturbed vegetation in the Tahoe Basin - Maintain at least 4% meadow and wetland vegetation.

Type of Standard: Management Standard with numeric target

Indicator (Unit of Measure) – Percent (%) of the landscape dominated by meadow and wetland vegetation

Status – The most recent data (USDA 2009c) indicates that there is about 7,385 acres of the meadow and wetland vegetation types in the Region. The management target set an objective to achieve and maintain at least 7,956 acres (or 4% of the land area) of these vegetation types. Based on this target, the region is at about 93% of the management target or about 7% below the management target. Consequently, a determination of "somewhat worse than target" was assigned to this indicator.

Trend – The trend determination was "unknown" due to differences in mapping approach and resolution across years.

Confidence

Status – According to an accuracy assessment conducted by the U.S. Forest Service Remote Sensing Lab (2009) on the most recent vegetation type map, there is 100% confidence that the mapped data accurately represents the distribution and extent of these vegetation types (herbaceous) on the landscape. Therefore a confidence of "high" was assigned to status.

Trends – Due to differences in mapping resolution and evaluation approach over time, there was "low" confidence assigned to trend.

Overall Confidence – Confidence assigned to status was 'high," and to trend "low," therefore, according to rules established for this report, overall confidence was assigned a "moderate" determination.

Interim Target – Trend information is not reliable for this indicator due to differences in mapping resolution and evaluation procedures across years. As a result, it is not possible to accurately estimate an interim target. A conservative interim target would be to increase the total acreage of this vegetation type by the next evaluation date.

Target Attainment Date – It is estimated that an additional 570 acres of meadow and wetland vegetation cover is needed to achieve the lower bounds of this management target. It is unlikely that a substantial amount of additional acreage for these vegetation types will be gained in the Region unless areas of existing urban development are removed and/or relocated and/or upland vegetation types are converted to the meadow or wetland vegetation type. Small gains in acreage could be realized through the restoration of meadows and wetlands that have been disrupted by past land use (e.g., re-establish fire and/or actively remove encroaching conifers from meadows and wetlands, and reconnect streams with flood plain). Consequently, it is unlikely that this management target will ever be achieved as currently adopted without the removal of existing development. A more in-depth assessment is needed to determine the "attainability" of this standard.

Human & Environmental Drivers – Several factors can influence the extent of meadow vegetation in the Tahoe Basin. The primary factors responsible for meadow and wetland vegetation are the geomorphic setting and the seasonal or permanent presence of surface groundwater, subsurface groundwater, and/or saturated soil (Potter 2005; Mitsch et al. 2009). A regular fire-return frequency in the Region historically contributed to the maintenance of meadow vegetation by eliminating encroaching conifer trees (USDA 2000). Historical grazing and Comstock era land uses changed how water moves through meadows and wetlands, resulting in dryer soils not capable of supporting meadow and wetland vegetation (USDA 2000). Urbanization has similarly altered the movement of water through meadow and wetland systems through impoundments, water rerouting, and the creation of impervious surface such as paved roads and building footprints (USDA 2000). Groundwater extraction for consumptive use may also influence the vigor of meadow and wetland vegetation in localized areas.

Monitoring Approach – Every five years, the Tahoe vegetation map is updated with new satellite data (if available) and/or modeled and calibrated using field-based Forest Inventory and Analysis (FIA) data to assess the extent of different vegetation types and associated forest structure characteristics for the Basin (USDA 2009c; Warbington et al. [no date]). For this evaluation, vegetation types associated with meadows and wetlands (CWHR type "WTM" [wet meadow] and "PGS" [Perennial Grassland]) were queried and enumerated from the most recently available vegetation map (U.S. Forest Service - Remote Sensing Lab Pacific Southwest Region: TMU_Strata_07 [published 2009]).

Monitoring Partners – U.S. Forest Service, US Geological Survey and Tahoe Regional Planning Agency

Programs and Actions Implemented to Improve Conditions – TRPA has adopted several policies and ordinances designed to promote the conservation and protection of existing meadow and wetland vegetation types (TRPA 1986; TRPA 1987a as amended in 2012). Agency partners affiliated with the Environmental Improvement Program have implemented numerous meadow and wetland restoration and enhancement projects, some of which have resulted in an increase in wetland and meadow vegetation acres (e.g., California Tahoe Conservancy's Cove East Project reclaimed 11.5 acres). Additional meadow and wetland restoration projects are currently planned as part of the EIP that will likely modestly increase the acreage of meadow and wetland vegetation types.

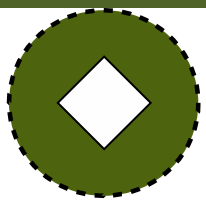
Effectiveness of Programs and Actions – Adopted policies and regulations in the *Regional Plan* have essentially halted further development in areas that support meadow and wetland vegetation types. Raumann and Cablk (2008) reported that between 1987 and 2002, no wetland/meadow vegetation was lost to urban development in the southern portion of the Region where the majority of these vegetation types occur. This research indicated that the existing regulations have been effective at protecting existing wetland and meadow vegetation types from development; however, they have not addressed the issue of natural succession where according to Raumann and Cablk (2008), on average 7.9 acres/year between 1987 and 2002 were converted to a forest cover type (i.e., non-wetland/meadow). Projects implemented through the EIP have been effective at restoring and enhancing existing acres of this vegetation type (about 629.5 acres Region-wide, see also Soil Conservation Chapter). However, only minor progress has been made to reclaim and restore meadows and wetlands (about 28 acres since 1987) that had previously been covered with urban development as part of TRPA's excess coverage mitigation program (TRPA data).

Recommendations for Additional Actions – The most recent acreage estimates showed that the proportion of wetland and meadow vegetation in the Basin is below the target set by TRPA's Threshold Standard to attain and maintain ≥4% of total land area. The management target directs the Region to achieve greater than 7,956 acres of these vegetation types in order to be in compliance with the Threshold Standard. However, it appears unlikely that Region will ever achieve this goal unless areas of developed urban lands are reclaimed and/or there is a willingness to artificially convert dryer upland vegetation to the wetland/meadow type. Modest increases can be realized through active conifer removal projects and the reestablishment of natural hydrologic regimes at wetland and meadows determined to be impacted by stream entrenchment, impoundments and water rerouting. Existing landuse policies and regulations may need to be amended to facilitate the transfer and restoration of urban development-oriented coverage from areas suitable for supporting wetland/meadow vegetation to areas with a greater capability to absorb the impact of coverage. Alternatively, the management target established for this Threshold Standard needs to be evaluated in concert with revised landuse regulations to determine a target that can be realistically achieved, and an estimate of acres of meadow that could be gained through restoration projects should be determined. This evaluation also identified challenges in determining trends associated with this indicator. The monitoring program should refine and document mapping procedures to improve trend estimates. In addition, indicators of wetland and meadow vegetation vigor and health

should be developed to improve our characterization of conditions related to these vegetation types and aid in prioritizing management actions.

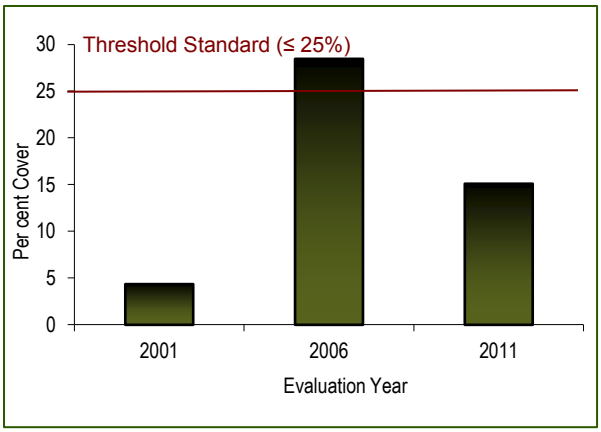
Common Vegetation: **Relative Abundance of Shrub Vegetation Type**

Status & Trend

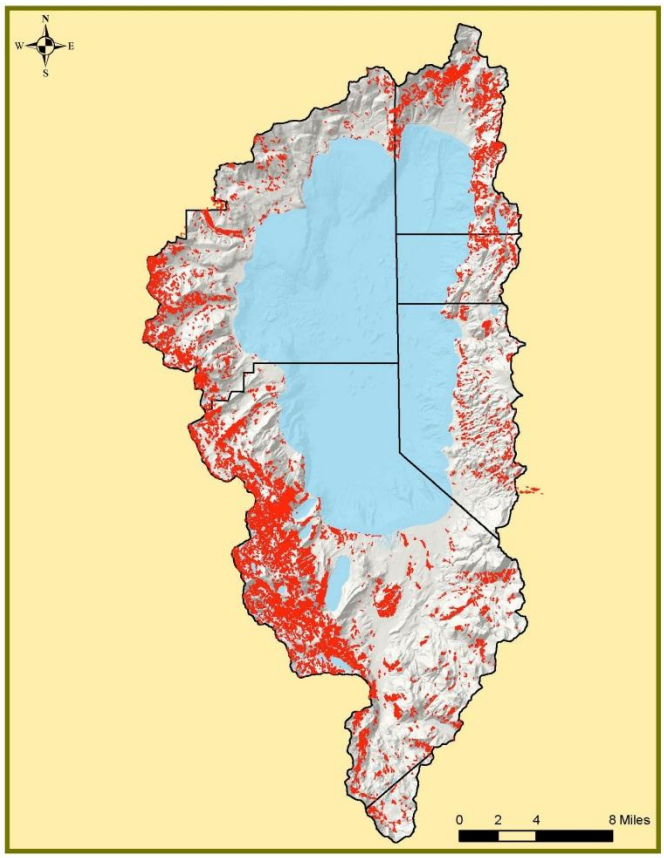


Relative Abundance of Shrub Vegetation Type
Status: **Considerably Better than Target**
Trend: **Unknown**
Confidence: **Low**

Map



Estimated percent of land area occupied by shrub vegetation in the Lake Tahoe Basin by evaluation year (TRPA 2001; TRPA 2007c; USDA 2009c).



Recent distribution and extent of shrub vegetation type (red areas in figure) in the Lake Tahoe Basin prior to the 2007 Angora Fire (USDA 2009c).

Data Evaluation and Interpretation

Relevance – This indicator measures the proportion of land cover dominated by shrub vegetation in the Tahoe Basin. Shrub vegetation represents an early successional stage of forest vegetation. The relative proportion of shrub type is important because it provides habitat for a wide diversity of wildlife species (USDA 2011c; Coppeto et al. 2006; Airola and Barrett 1985) and complements vegetation diversity in the Basin (USDA 2000). The relative abundance of shrub vegetation type in the Tahoe Basin is intended not to exceed 25% since it is most valued as habitat by an array of wildlife species when interspersed between other vegetation types, such as forests and meadows. Shrub vegetation is comprised of sagebrush, whitethorn, manzanita, bitterbrush, huckleberry oak, and chinquapin. This indicator does not provide an accurate measure of the extent and distribution of understory shrub vegetation or provide a measure of the relative condition of shrub vegetation.

Threshold Category – Vegetation

Indicator Reporting Category – Common Vegetation

Adopted Standards – (Relative Abundance) Of the total amount of undisturbed vegetation in the Tahoe Basin - Maintain no more than 25 percent dominant shrub association vegetation.

Type of Standard – Management Standard with Numeric Target

Indicator (Unit of Measure) – Percent of the landscape dominated by shrub vegetation (percent [%])

Status – The most recent data (which does not include the area affected by the 2007 Angora Fire) indicates that about 15% (approximately 30,041 acres) of the land area in the Region is covered by the shrub vegetation type. The management target for this Threshold Standard sets an objective to achieve and maintain less than 49,728 acres (or < 25% of the land area) of this vegetation type. Based on this target, the region is meeting this target by 39%. Consequently, a determination of "considerably better than target" was assigned to this indicator.

Trend – The trend determination was "unknown" due to differences in mapping resolution and evaluation approach across years.

Confidence

Status – According to an accuracy assessment conducted by the U.S. Forest Service Remote Sensing Lab (2009) on the most recent vegetation type map, there is 88% confidence that the mapped data accurately represents the distribution and extent of this vegetation

types (shrub) on the landscape. Therefore a confidence of "moderate" was assigned to status.

Trends – Due to differences in mapping resolution and approach over time, there was "low" confidence assigned to trend.

Overall Confidence – Confidence assigned to status was "moderate" and to trend "low," therefore according to rules established for this report, overall confidence was assigned a "low" determination.

Interim Target – According to the most recent data on vegetation, the Region is in attainment with the adopted management target. Therefore, it is not necessary to establish an interim target for this indicator.

Target Attainment Date – According to the most recent data on vegetation, the Region is in attainment with the adopted management target. Therefore, it is not necessary to establish a target attainment date for this indicator.

Human & Environmental Drivers – Several factors can influence the extent of shrub vegetation in the Tahoe Basin. The primary factors responsible for shrub vegetation are light exposure, soil type and moisture content, and extent and frequency of wildfire and other natural disturbances. Canopy-replacing wildfire is suspected of creating openings conducive to the establishment of contiguous shrub vegetation on the landscape, although shrub vegetation is known to also occupy the understory of most mixed conifer forest landscapes in the Region.

Monitoring Approach – Every five years, the Tahoe vegetation map is updated with new satellite data (if available) and/or modeled and calibrated using field-based Forest Inventory and Analysis (FIA) data to assess the extent of different vegetation types and associated forest structure characteristics for the Basin (USDA 2009c; Warbington et al. [no date]). For this analysis, CWHR vegetation types associated with shrubs were queried and enumerated from the most recently available vegetation map (U.S. Forest Service - Remote Sensing Lab Pacific Southwest Region: TMU_Strata_07 [published 2009]). The following CWHR types were queried to represent shrub vegetation in this evaluation:

TRPA Association	California Wildlife Habitat Relationship Type
Sagebrush Scrub	Bitterbrush
Sagebrush Scrub	Low Sagebrush
Sagebrush Scrub	Sagebrush
Shrub	Alpine Dwarf Shrub
Shrub	Montane Chaparral

Monitoring Partners – U.S. Forest Service, US Geological Survey and Tahoe Regional Planning Agency

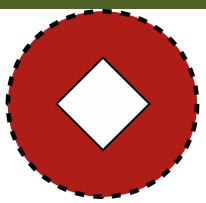
Programs and Actions Implemented to Improve Conditions – TRPA has adopted policies and ordinances designed to promote a diversity of native vegetation communities in the Region (TRPA 1986; TRPA 1987a as amended in 2012). TRPA currently does not have policies or regulations specific to the conservation of shrub vegetation. Forest fuels reduction projects affiliated with the Environmental Improvement Program (EIP) tend to target the removal of understory shrubs to meet fuels reduction objectives and to prevent an overabundance of shrub-dominated vegetation type.

Effectiveness of Programs and Actions – Existing policies and regulations appear to be effective based on the current status of this indicator. The existing extent and distribution of the shrub vegetation type is however more likely a function of natural disturbance processes and succession occurring in upland ecosystems.

Recommendations for Additional Actions – The currently adopted Threshold Standard is problematic. First, it suggests the Region would be in attainment with the standard even if there was no shrub cover on the landscape. However, this outcome would be contrary to achieving the Threshold Standard for species richness, creating a possible direct conflict between the two Threshold Standards. Second, an accounting of the spatial extent (acres) of shrub vegetation does not provide managers with an understanding of the relative condition of this vegetation type. Therefore, it is recommended that the current standard be evaluated to determine if an alternative standard (and associated indicators) could be used to characterize this dimension of the Tahoe Basin's vegetation community.

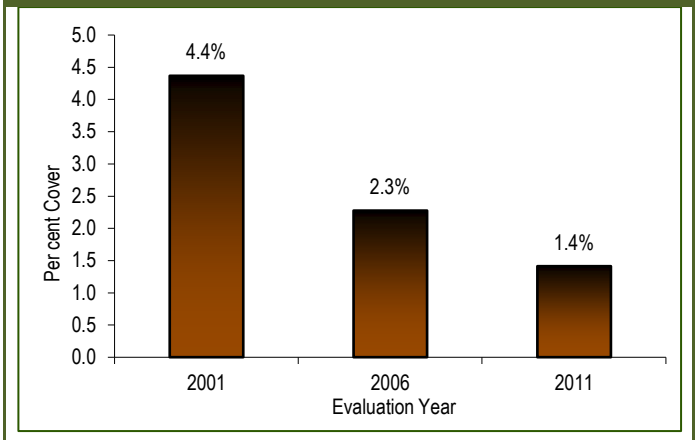
Common Vegetation: **Relative Abundance of Deciduous Riparian Vegetation Type**

Status



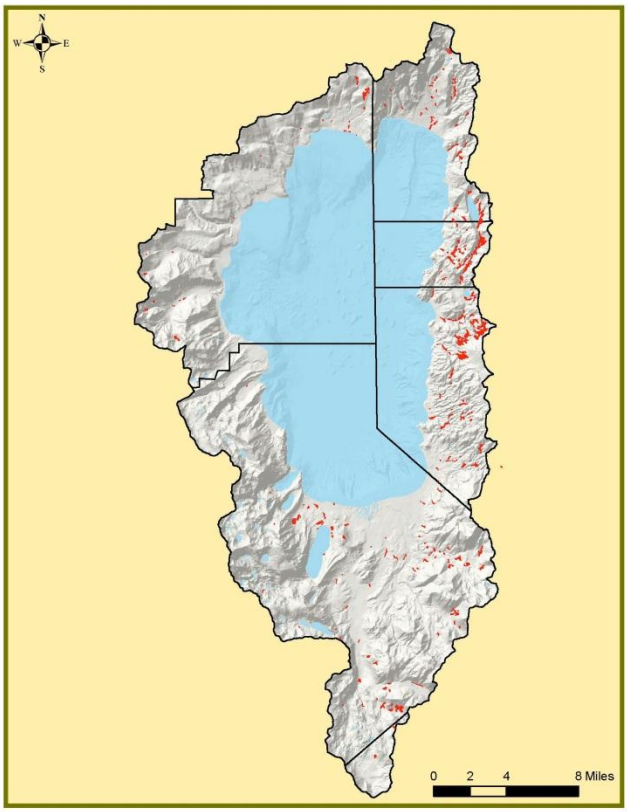
Relative Abundance of Deciduous Riparian Vegetation Type
Status: **Considerably Worse than Target**
Trend: **Unknown**
Confidence: **Low**

Trend



Estimated percent of land area covered by deciduous riparian vegetation in the Lake Tahoe Basin by evaluation year (TRPA 2001; TRPA 2007c; USDA 2009c).

Map



Distribution and extent of deciduous riparian vegetation type (red areas in figure) in the Lake Tahoe Basin prior to the 2007 Angora (USDA 2009c).

Data Evaluation and Interpretation

Relevance – This indicator measures the relative proportion of land covered by riparian hardwoods (known as deciduous riparian vegetation) in the Tahoe Basin. This vegetation grouping is commonly associated with moist soils adjacent to streams, springs, wetlands and small lakes (Potter 2005). Species considered to be riparian hardwood include alder, aspen, willow, cottonwood, and dogwood. The relative proportion of riparian hardwoods is important because this vegetation type enhances vegetation richness in the Basin, provides habitat for a relatively high diversity of wildlife species (including sensitive species) and is rare in the Lake Tahoe Basin (USDA 2000; Manley and Schlesinger 2001). Riparian hardwoods are also resilient to natural disturbance, such as flooding and fire (Sheppard et al. 2006). This indicator does not measure the condition or vigor of riparian hardwoods. This indicator can also be used as a proxy to assess the Common Vegetation Management Standard that calls for non-degradation of plant communities including native deciduous trees, wetlands and meadows, while providing for opportunities to increase the acreage of such riparian associations.

Threshold Category – Vegetation

Indicator Category – Common Vegetation

Adopted Standards – (Relative Abundance) 1) Of the total amount of undisturbed vegetation in the Tahoe Basin – maintain at least 4% deciduous riparian vegetation, 2) A non-degradation standard to preserve plant communities shall apply to native deciduous trees, wetlands, and meadows while providing for opportunities to increase the acreage of such riparian associations to be consistent with the SEZ threshold.

Type of Standard – 1) Management Standard with Numeric Target (achieve 4%); 2) non-degradation Management Standard for riparian vegetation

Indicator (Unit of Measure) – Percent of the landscape dominated by deciduous vegetation (percent [%])

Status – The most recent data (not including area affected by the 2007 Angora Fire) indicates that about 1.4% (approximately 2,808 acres) of the land area in the Region is covered by the deciduous riparian vegetation type. The management target for this Threshold Standard sets an objective to achieve and maintain at least 7,956 acres (or 4% of the land area) of this vegetation type. Based on this

target, the Region is at about 35% of the target. Consequently, a determination of "considerably worse than target" was assigned to this indicator. The non-degradation Management Standard was determined to be implemented because the agency has adopted regulatory control measures to prohibit actions that can degrade the quality of riparian vegetation. In addition, the Environmental Improvement Program (EIP) has facilitated the implementation of vegetation restoration projects designed to restore the health of deciduous vegetation.

Trend – The trend determination was "unknown" due to differences in mapping resolution and evaluation approach across years.

Confidence

Status – According to an accuracy assessment conducted by the U.S. Forest Service Remote Sensing Lab (2009) on the most recent vegetation type map, accuracy was not assessed for the riparian hardwood type. Therefore, a confidence of "low" was assigned to status.

Trends – Due to differences in mapping resolution and evaluation approach over time, there was "low" confidence assigned to trend.

Overall Confidence – Confidence assigned to status was "low" and to trend "low," therefore according to rules established for this report, overall confidence was assigned a "low" determination.

Interim Target – Trend information is not reliable for this indicator due to differences in mapping resolution and evaluation procedures across years. As a result, it not possible to estimate an interim target. A conservative interim target may be to increase acreage of this vegetation type by the next evaluation date.

Target Attainment Date – It is estimated that an additional 5,148 acres of riparian deciduous vegetation cover is needed to achieve the lower bounds of this management target. Some gains in acreage could be realized through the restoration of riparian areas that have been disrupted by past land use (e.g., re-establish fire and/or actively remove encroaching conifers from riparian areas, or reconnect streams with the flood plain). Any gains in acreage of riparian vegetation would support the non-degradation standard that calls for increasing acreage of riparian associations where possible and appropriate. However, it is unlikely that a substantial amount of additional acreage for these vegetation types will accrue in the Region unless there is a willingness to remove areas of existing urban development and/or there is a willingness to convert upland vegetation types to the riparian deciduous type. Consequently, it is unlikely that this management target will ever be achieved as currently adopted and articulated.

Human & Environmental Drivers – Moist soils, direct sunlight and natural disturbance influence the abundance and distribution of riparian hardwoods. Fire suppression has allowed encroachment of shade-tolerant white fir into areas previously dominated by riparian hardwood species.

Monitoring Approach – Every five years, the Tahoe vegetation map is updated with new satellite data (if available) and/or modeled and calibrated using field-based Forest Inventory and Analysis (FIA) data to assess the extent of different vegetation types and associated forest structure characteristics for the Basin (USDA 2009c; Warbington et al. [no date]). For this analysis, CWHR vegetation types associated with deciduous riparian vegetation ("Montane Riparian," "Aspen," and "Mix Hardwood/Conifer") were queried and enumerated from the most recently available vegetation map (U.S. Forest Service - Remote Sensing Lab Pacific Southwest Region: TMU_Strata_07 [published 2009]).

Monitoring Partners – U.S. Forest Service, US Geological Survey and Tahoe Regional Planning Agency

Programs and Actions Implemented to Improve Conditions – TRPA has adopted several policies and ordinances designed to promote the conservation and protection of existing deciduous vegetation types (TRPA 1986; TRPA 1987a as amended in 2012). Agency partners affiliated with the EIP have implemented numerous deciduous riparian restoration and enhancement projects (amounting to about 718 acres between 2005 and 2011) – mostly by removing encroaching conifers from aspen stands. Additional deciduous riparian restoration projects are currently planned as part of the EIP that will likely increase the acreage of this vegetation type.

Effectiveness of Programs and Actions – Adopted policies and regulations in the *Regional Plan* have essentially halted further development in areas that support deciduous vegetation types (Raumann and Cablk 2008). Projects implemented through the EIP have been effective at restoring existing acres (about 718 acres) of this vegetation type (especially for aspen, where shade tolerant white fir were removed). Existing regulations may limit well-intentioned conifer removal treatments from areas suitable for supporting deciduous riparian vegetation or otherwise make treatment of those areas cost-prohibitive; existing regulations should be evaluated and amended if necessary to facilitate projects that would benefit areas of deciduous riparian vegetation.

Recommendations for Additional Actions – The most recent acreage estimates showed that the proportion of deciduous riparian vegetation in the Basin is substantially below the management target set by TRPA's Threshold Standard to attain and maintain ≥4% of total land area. The management target directs the Region to achieve greater than 7,956 acres of these vegetation types in order to be in compliance with the Threshold Standard. Modest increases can be realized through active conifer removal projects and the reestablishment of natural hydrologic regimes at riparian areas determined to be impacted by stream entrenchment, impoundments, and water rerouting (Sheppard et al. 2006). Existing landuse regulations may need to be amended to facilitate the transfer and restoration of urban development-oriented coverage from areas suitable for supporting deciduous riparian vegetation, to areas with a greater capability to absorb the impact of coverage. The management target established for this Threshold Standard needs to be evaluated in concert with revised landuse regulations to determine a target that can be realistically achieved. This evaluation also identified challenges in determining trends associated with this indicator. The monitoring program should refine and document mapping procedures to improve trend estimates. In addition, indicators of deciduous vegetation vigor and health should be developed to improve the characterization of conditions related to these vegetation types and aid in prioritizing management actions.

Common Vegetation (Pattern): **Juxtaposition of Vegetation Communities and Age Class**

Reporting Icon

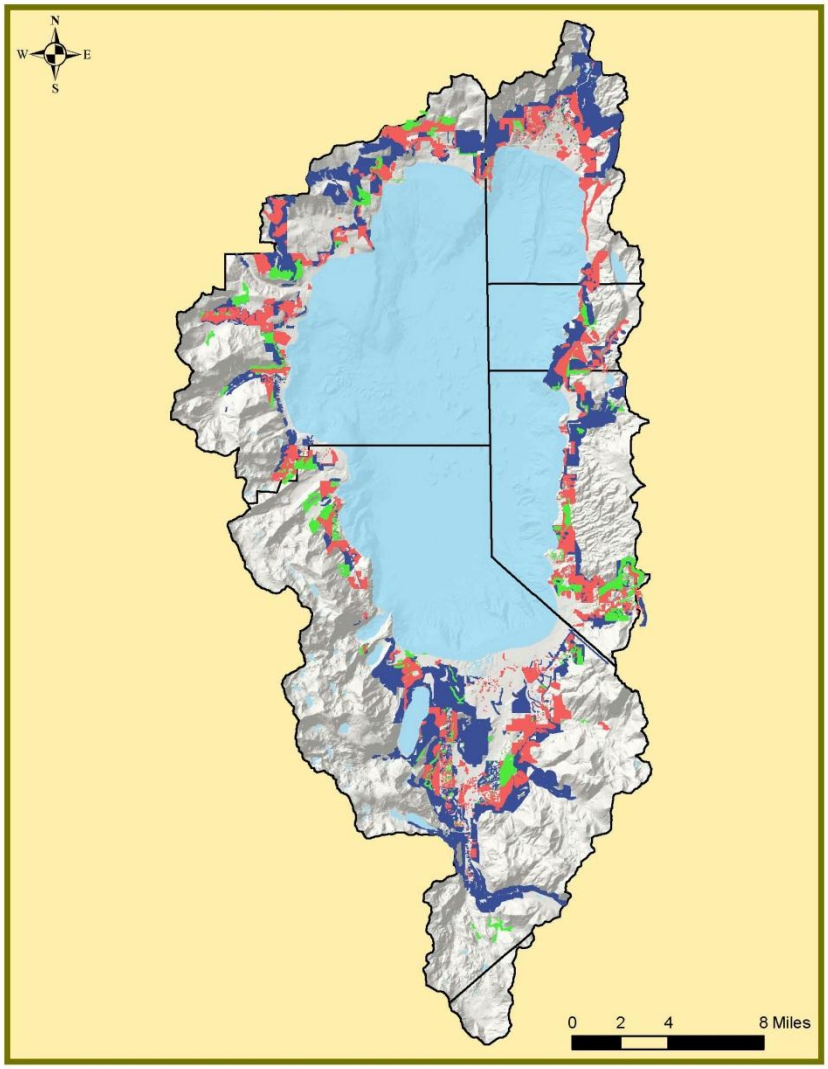
Status: **Implemented**

Photos

Area before fuels reduction treatment.

Same area after fuels reduction treatment. Note: Treatment area shown in image is typical of forest treatments completed in the Lake Tahoe Basin. Forest treatments permitted under the *1987 Regional Plan as amended in 2012* do not allow the creation of openings greater than 8 acres.

Map



Map showing the distribution of fuels reduction treatments (pink = completed, green = partially completed, blue = in planning stage) in the Lake Tahoe Basin. Source: U.S. Forest Service, Tahoe Fire and Fuels Team (2011).

Data Evaluation and Interpretation

Relevance – Vegetation is integral to many scenic and recreational amenities in the Lake Tahoe Basin. Vegetation also provides many functional roles related to water cleansing, soil stabilization, wildlife habitat, nutrient catchment and release, air purification, and noise control. The focus of vegetation preservation in the Basin is to restore, protect and maintain these functions and contribute to other socioeconomic attributes. Specifically, this Management Standard discourages the creation of large forest openings, such as clear cuts, while providing tools to allow for forest openings of up to eight acres in size to meet specific management goals such as regeneration of shade intolerant species (e.g., Jeffery and sugar pine). It also encourages the perpetuation of a diversity of tree age classes, which is important for ensuring the sustainability of the Region's forests.
Threshold Category – Vegetation
Indicator Reporting Category – Common Vegetation
Adopted Standards – Pattern **–** Provide for the proper juxtaposition of vegetation communities and age classes by 1) Limiting acreage size of new forest openings to no more than eight acres, and 2) Adjacent openings shall not be the same relative age class or

successional stage to avoid uniformity in stand composition and age.

Type of Standard – Management

Status – The Region is in attainment with this Management Standard. Policies and ordinances are in place to sustain common vegetation and a vegetation management restoration program has been underway to actively reduce unnaturally dense forest and restore fire resiliency of Tahoe's upland ecosystems (TRPA 1986; TRPA 1987a as amended in 2012). With few exceptions, the *Code of Ordinances* prohibits the manipulation of vegetation that would permanently impact forest integrity (TRPA 1987a as amended in 2012). TRPA is required to conduct a formal environmental review, including consideration of alternatives and mitigation measures, when a project may have a significant impact on common vegetation or other Threshold Standards (TRPA 1987a as amended in 2012). Prior to approving any vegetation management project, TRPA must make specific findings demonstrating that the project is consistent with the *Regional Plan* and will not exceed any environmental Threshold Standard, including requirements for protecting upland and riparian vegetation (TRPA 1987a as amended in 2012). TRPA administers the interagency Environmental Improvement Program (EIP), which facilitates the implementation of forest health restoration and other vegetation management projects.

Human & Environmental Drivers – The current structure and distribution of vegetation in the Tahoe Basin is mostly the result of past land management activities, wildfire and fire suppression, grazing and urban development. Grazing, logging and fire exclusion have all played roles in past degradation of areas that support common vegetation. Prior to European settlement, low intensity fires burned every 5-18 years in lower elevation pine and mixed conifer forests in the Tahoe Basin (Taylor 2004). As a result, these lower elevation forests in the Basin typically had large, widely spaced conifers with a poorly developed shrub understory, in a mosaic pattern of different age classes from some higher-intensity, stand-replacing fires. Between 1875 and 1895, large-scale timber harvesting removed most of the large trees around Lake Tahoe (Lindstrom et al. 2000). Although the forest stands successfully regenerated, the past 100 years of fire suppression, and a reduced emphasis on forest management has resulted in a more homogenous landscape of denser, even-aged forests and increased fire hazards.

Management Partners – The U.S. Forest Service, California Tahoe Conservancy, California State Parks, CAL FIRE, Nevada Division of Forestry, North Lake Tahoe Fire Protection District, Tahoe-Douglas Fire Protection District, Lake Valley Fire Protection District, Meeks Bay Fire Protection District, City of South Lake Tahoe, Fallen Leaf Fire Protection District and North Tahoe Fire Protection District all contribute to the implementation and monitoring of forest management activities in the Tahoe Basin.

Programs and Actions Implemented to Improve Conditions – Fuels reduction treatments in the Tahoe Basin (above map) have enhanced implementation of the Juxtaposition of Vegetation Communities and Age Class Indicator. While most fuels reduction treatments are relatively similar in nature and consist of understory ladder fuel removal and forest thinning, they are not thought to homogenize the landscape since they are typically interspersed between dense, even-aged untreated forests. This results in a mosaic pattern across a large area. Significant regulatory protections exist in the *Code of Ordinances*, which regulate the prescriptions and methods of forestry operations. Since the creation of the EIP in 1997, over 45,000 acres of forest have been treated, and over 3,000 acres of lands have been protected through public acquisition (TRPA 2009).

Effectiveness of Programs and Actions – Since the adoption of the *Regional Plan*, TRPA's application of regulations through project review has improved and protected common vegetation in the Tahoe Basin (Raumann and Cablk 2008).

Recommendations for Additional Actions – Continue existing policies and ordinances. There are no recommendations for additional action at this time.

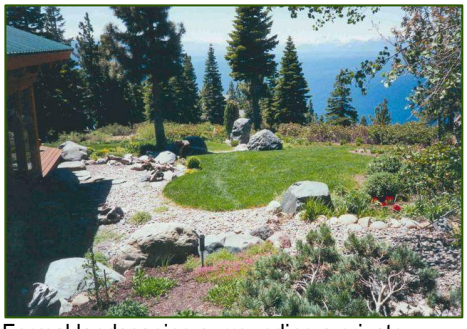
Common Vegetation (Pattern): **Consistency with Bailey Land Capability System**

Reporting Icon

Status: **Implemented**

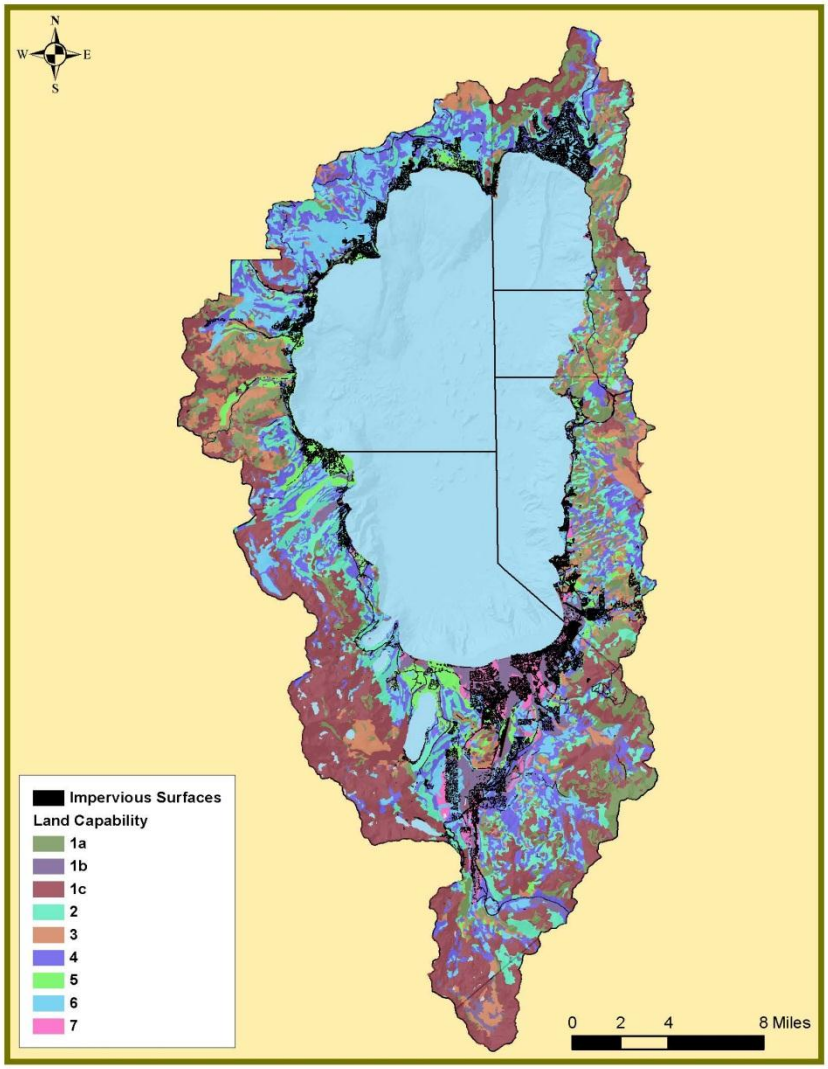
Photos

Native landscaping surrounding a private home.



Formal landscaping surrounding a private home.

Map



Map showing the extent and distribution of impervious surface in the Lake Tahoe Basin relative to Land Capability Districts. Source: TRPA GIS

Interpretation and Commentary

Relevance – Vegetation is integral to many scenic, wildlife, and recreational amenities in the Lake Tahoe Basin. Vegetation also fulfills many functional roles related to water cleansing, soil stabilization, nutrient catchment and release, air purification, and noise control. The focus of vegetation preservation in the Basin is to protect and maintain these and other attributes.

Threshold Category – Vegetation

Indicator Category – Common Vegetation

Adopted Standards – Native vegetation shall be maintained at a maximum level to be consistent with the limits defined in the *Land Capability Classification of the Lake Tahoe Basin, California-Nevada, A Guide For Planning* (Bailey 1974), for allowable impervious cover and permanent site disturbance.

Type of Standard – Management

Status – The Management Standard has been implemented and is in attainment. Regulations are in place to limit the amount of allowable impervious coverage through the implementation of the Bailey land capability system. At the parcel level, the application of the land capability system requires that areas not covered by impervious surfaces be left in a native, or acceptably landscaped state.

Human & Environmental Drivers – The current structure and distribution of vegetation in the Tahoe Basin is mostly the result of past land management activities, such as urban development. Some areas in the Tahoe Basin have exceeded the impervious coverage limits set by Bailey (1974). These areas are typically commercial core areas, and efforts are currently underway to bring those areas into compliance. Landscaping around homes is typically left as native vegetation, or is converted into a more formal landscape, usually including irrigation and some non-native plants (lawns and flowers).

Management Partners – City of South Lake Tahoe, Natural Resources Conservation Service, Placer, El Dorado, Washoe and Douglas Counties, Tahoe Resource Conservation District, and Nevada Tahoe Conservation District.

Programs and Actions Implemented to Improve Conditions – The *Code of Ordinances* has a significant regulatory framework for development, allowable coverage and assessing land capability. These programs have been in place and effective since 1987. The *Home Landscaping Guide for Lake Tahoe and Vicinity* (Cobourn et al. 2002) provides guidance for Lake Tahoe homeowners and includes landscaping recommendations for balancing erosion control with fire defensible space.

Effectiveness of Programs and Actions – Since the adoption of the *Regional Plan*, TRPA's application of regulations through project review has improved and protected common vegetation in the Tahoe Basin and provided guidance on appropriate landscaping.

Recommendation for Additional Actions – Continue implementation of the land capability system and work with partners on list of approved vegetation for landscaping.

Policy Statement Assessment for Common Vegetation: Appropriate Management Practices

Relevance – Forest management activities have the potential for substantial impacts on the environment. However, the forests of Lake Tahoe are in need of active management to maintain forest health and reduce the threat of wildfire. The importance of appropriate low-impact forest management cannot be overstated, and this Policy Statement was intended to ensure that forest management activities comply with all *Regional Plan* policies and ordinances adopted to achieve multiple TRPA Threshold Standards.

Adopted Standard – It shall be a policy of the TRPA Governing Board that a non-degradation standard shall permit appropriate management practices.

Type of Standard – Policy Statement

Evaluation Criteria – This Policy Statement was evaluated by determining 1) whether TRPA and other agencies have sufficiently adopted policies, ordinances and programs in support of the threshold Policy Statement and 2) whether TRPA and other agencies have been diligent in the implementation of best forestry practices.

Criteria 1: Chapter 62 of the *Code of Ordinances* regulates tree removal and forest management activities with ordinances that address techniques for forest management that reduce impacts to less than significant, and improve or maintain TRPA Thresholds. These ordinances are applied through memoranda of understanding with land management agencies, and through the permit review process.

Criteria 2: Timber management project permitting begins with TRPA forestry staff reviewing proposed project plans and working with the project proponent to change and/or modify the proposed plan to meet all TRPA adopted policies and ordinances, and to ensure all impacts are less than significant. After agreement on the plan and appropriate environmental analysis, forestry staff issues a permit with special conditions. When the project is implemented, staff inspects the operations to ensure compliance with the conditions of the permit, and to ensure that all best management practices (BMPs) are in place. After the project is completed, TRPA forestry staff inspects the final project for compliance with all permit conditions, and to ensure the project site has been properly winterized.

The vast majority of forest management work in the Tahoe Basin is completed using either hand crews or low-impact ground based equipment; however, helicopters and cable yarding have also been used. Low-impact ground-based equipment is typically rubber-tired machines that exert low ground pressure, and therefore cause less ground disturbance and soil compaction than traditional forest management equipment. Cut-to-length systems that include a rubber-tired harvester and a rubber-tired forwarder are the machines most commonly used in the Lake Tahoe Basin. These machines have been demonstrated for use in some Stream environment zones without substantial impacts (Norman et al. 2008).

The U.S. Forest Service – Lake Tahoe Basin Management Unit (LTBMU) implements timber management projects according to Forest Service guidelines and a Forest Plan that is specific to the Tahoe Basin. These documents include many of the protections and best management practices currently in the *Regional Plan*. The LTMBU also follows a best management practices handbook for all projects in California to ensure compliance with the California State Water Board requirements.

The California Tahoe Conservancy, California State Parks, Nevada Division of State of State Lands, and the five fire protection districts and one fire department in the Lake Tahoe Basin follow all applicable local, state, and federal laws, and employ resource professionals to plan and implement their projects.

Entities implementing forestry projects in the Basin follow the *Code of Ordinances,* and work closely with TRPA forestry staff when planning and implementing projects. When protection measures required by TRPA differ from local, state, or federal laws, the strictest protection measures are implemented.

Attainment Status – Based on the evaluation criteria, it was determined that TRPA and other agencies have sufficiently incorporated the appropriate forest management policies into their respective planning documents, and ensure their application during the implementation of forestry projects.

Interim Target – It was determined that TRPA and other agencies have sufficiently adopted best forestry practices and that it is not necessary to establish an interim target.

Target Attainment Date – It was determined that TRPA and other agencies have sufficiently adopted best forestry practices and that it is not necessary to establish a target attainment date.

Recommendations for Additional Actions – This evaluation has demonstrated that both TRPA and other agencies have adopted and are implementing appropriate forest management practices in the Lake Tahoe Basin. It is recommended that this Threshold Standard be removed from the list of adopted Threshold Standards as originally intended, or replace the current Policy Statement with a Numerical Standard that can be objectively evaluated.

Late Seral and Old Growth Forest Ecosystems

Old growth forests are generally defined as forests in their later stages of development, usually referred to as late seral, late successional, or simply old growth. Approximately four million acres of old growth forest remains in the Sierra Nevada. However, most of the remaining stands have been fragmented, with the majority of old growth stands found in hard-to-access upper elevations, protected areas in lower elevations, or in steep stream canyons (Beardsley et al. 1999). In the Tahoe Basin, up to 60 percent of the large and old trees that existed on the landscape were harvested to support Comstock mining, and other timber demands between 1860 and 1900 (USDA 2000; Elliot-Fisk et al. 1996). Tree sizes for old growth have been differentially defined as trees over 24" diameter at breast height (dbh), with medium to high canopy cover, to trees 30" dbh and greater (USDA 2001). Age is difficult to determine based on tree diameter because some very old trees do not exhibit large girth (e.g., whitebark pine). Similarly, many large diameter trees do not exhibit the structure of old, mature trees, namely rounded or flattened tops and large diameter limbs. In the Sierra Nevada, old growth refers to trees a minimum of 150-200 years old. Tree size and age-related structure are a result of growing conditions (e.g., soils, aspect, and water availability), tree species, elevation, natural disturbance (e.g., wildfire) and climatic conditions resulting from the diverse ecosystems in the Sierra Nevada.

TRPA adopted Numerical Threshold Standards for old growth in 2001 in response to the Sierra Nevada Forest Plan amendments (USDA 2001). The USFS (USDA 2001) environmental impact statement found that old growth forests in the Sierra Nevada were critical habitat for a wide range of wildlife species, including sensitive species (e.g., California spotted owl), and that these systems were in decline as a result of previous land management practices (USDA 2001). The USFS (USDA 2001, USDA 2000) and the Sierra Nevada Ecosystem Project (Elliott-Fisk et al. 1996) estimated that approximately 55 percent of forests in the Sierra Nevada could be classified as old growth. TRPA used this information to establish numerical targets for the Late Seral and Old Growth Forest Ecosystems Threshold Standard. Numerical Standards for late seral and old growth forest ecosystems are listed in Table 6-1 above.

Section 62.1.3 of the *Code of Ordinances* addresses enhancement and protection of late seral and old growth forests, and provides protection for trees larger than 30" dbh in westside forests, and larger than 24" dbh in eastside forests. Although the acreage of late seral and old growth ecosystems in the Basin in the greater than 24" diameter class may be overestimated, stands dominated by trees greater than 24" dbh were used to obtain an estimate of the acreage of late seral and old growth ecosystems for this evaluation since more accurate data on old growth ecosystems was not available.

TRPA Threshold Standards for old growth forests are associated with three elevation zones within the Region; Montane (<7,000'), Upper Montane (7,000' to 8,500'), and Subalpine (>8,500'). The relative abundance of stands dominated by large trees was evaluated to characterize the overall status of the Late Seral and Old Growth Forest Ecosystem Indicator Reporting Category. For each elevation zone, the Region was determined to be "considerably worse than target," with an "unknown" trend and "low" confidence, resulting in an overall characterization that mirrored the status of each elevation zone (Figure 6-2). This should not be surprising as it was acknowledged that it would take 100 years to achieve these Threshold Standards from the time that they were adopted.

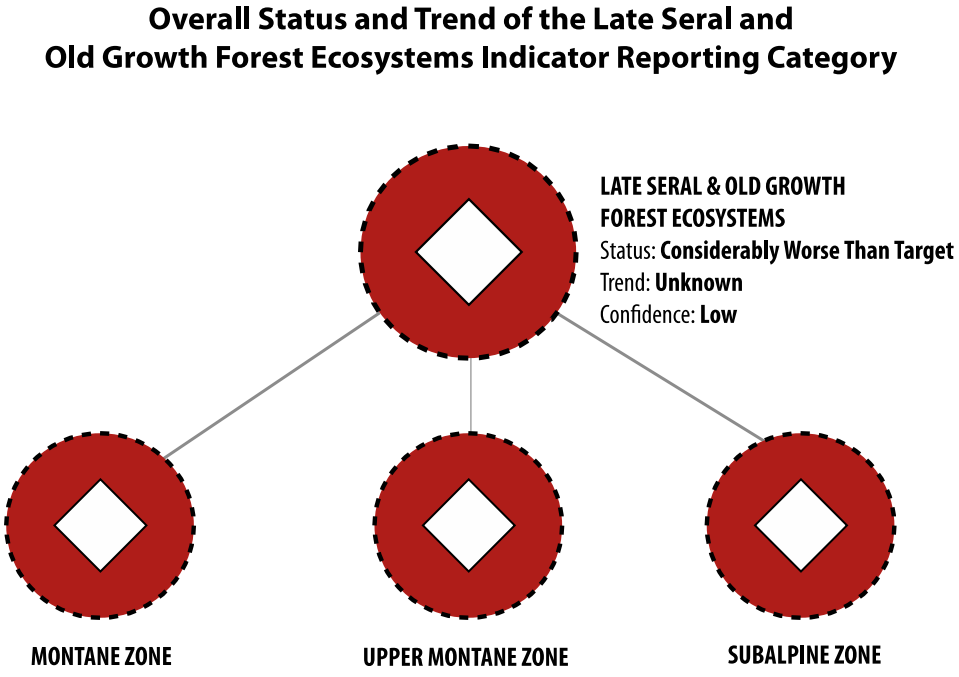


Figure 6-2. *Reporting icons for the three indicators evaluated in the Late Seral and Old Growth Forest Ecosystems Indicator Reporting Category. Results from each of the three indicators (bottom) were evaluated and aggregated to characterize the overall status of the Late Seral and Old Growth Forest Ecosystems Indicator Reporting Category (top).*

Late Seral and Old Growth Forest Ecosystems: **Relative Abundance of Late Seral and Old Growth Forest Ecosystems for Montane, Upper Montane and Subalpine Elevation Zones**

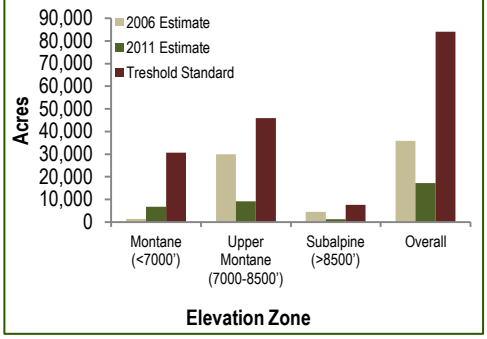
Status

MONTANE ZONE
Status: **Considerably Worse than Target**
Trend: **Unknown**
Confidence: **Low**

UPPER MONTANE ZONE
Status: **Considerably Worse than Target**
Trend: **Unknown**
Confidence: **Low**

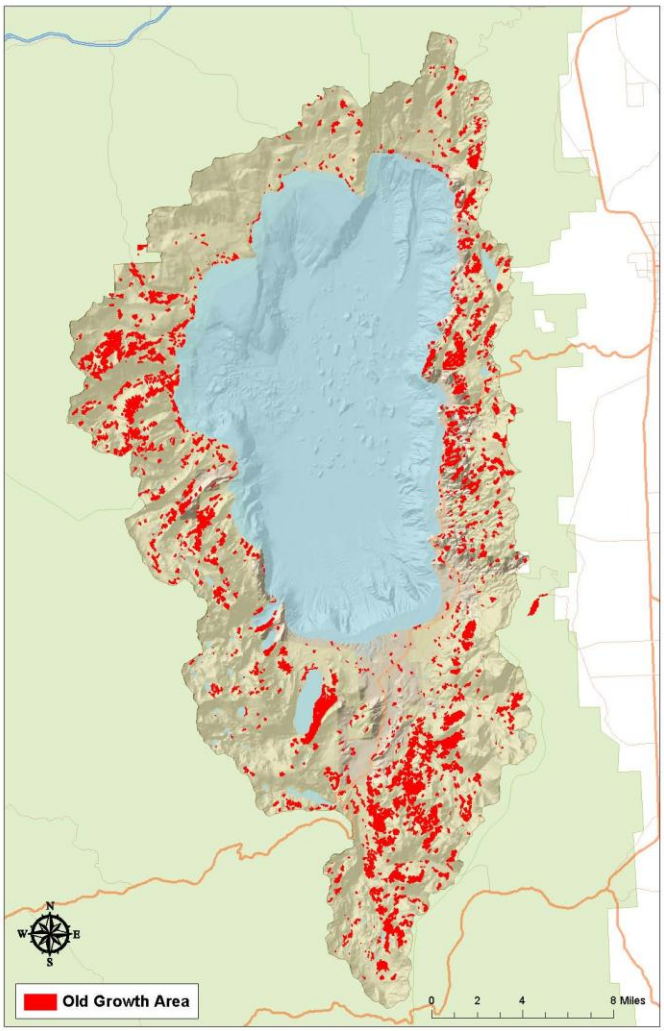
SUBALPINE ZONE
Status: **Considerably Worse than Target**
Trend: **Unknown**
Confidence: **Low**

Graph



Estimated aerial extent in acres of conifer stands dominated by trees >24" dbh ("old growth" forest stands) in the Lake Tahoe Basin relative to adopted TRPA standard, by elevation zone (TRPA 2001; TRPA 2007c; USDA 2009c).

Map



Recent geographic distribution and extent of conifer stands dominated by trees >24" dbh ("old growth" forest stands; red areas in figure) in the Lake Tahoe Basin. Source: U.S. Forest Service (2007 EVEG).

Data Evaluation and Interpretation

Relevance – This indicator characterizes the geographic extent of stands dominated by large diameter (>24" dbh) conifer trees in the Tahoe Region. Old growth forests are valued because they typically include large trees that are well spaced, and add to Tahoe's ecological integrity by providing a greater diversity of life forms, including a variety of unique lichen, fungi, insects, vegetation and wildlife. Old forests tend to be more structurally complex and resilient to natural disturbances (wildfire) than younger forests, due to tree spacing and fire resistance of bark on mature trees, especially pines. This indicator does not measure the relative condition of this vegetation type.

Threshold Category – Vegetation

Indicator Reporting Category – Late Seral and Old Growth Forest Ecosystems

Adopted Standards – Attain and maintain a minimum percentage of 55% by area of forested lands within the Tahoe Region (excluding TRPA designated urban areas) in a late seral or old growth condition, and distributed across elevation zones. To achieve the 55%, the elevation zones shall contribute as follows:

- The Subalpine zone (greater than 8,500 feet elevation) will contribute 5% (7,600 acres) of the late seral or old growth acres (61% of the Subalpine zone must be in a late seral or old growth condition)
- The Upper Montane zone (between 7,000 and 8,500 feet elevation) will contribute 30% (45,900 acres) of the late seral or old growth acres (60% of the Upper Montane zone must be in a late seral or old growth condition)
- The Montane zone (lower than 7,000 feet elevation) will contribute 20% (30,600 acres) of the late seral or old growth acres (48% of the Montane zone must be in a late seral or old growth condition)

Type of Standard – Numerical

Indicator (Unit of Measure) – Percent (%) of the forested landscape dominated by large diameter (>24" dbh) conifer trees

Status – The most recent data (which does not include the area affected by the 2007 Angora Fire) indicates that about 20.5% (approximately 17,280 acres) of the forested landscape is covered by stands dominated by trees >24" dbh, indicating that the region is "considerably worse than target." According to recent mapping information, there are approximately 6,814 acres of large-tree dominated stands in the Montane zone (<7,000'), indicating that the Region is approximately 78% below the target of 30,600 acres. In the Upper Montane zone, there are approximately 9,195 acres of large-tree dominated stands, indicating the Region is approximately 80% below the target of 45,900 acres. The Subalpine zone contains about 1,269 acres of large-tree dominated stands, indicating that the Region is about 83% below the target of 7,600 acres. Consequently, the status of each zone was determined to be "considerably worse than target."

Trend – The trend determination is "unknown" due to differences in mapping resolution and evaluation approach across years.

Confidence

Status – According to an accuracy assessment conducted on the most recent vegetation size class map by the U.S. Forest Service Remote Sensing Lab in 2009, accuracy was 60%. Therefore, a confidence of "moderate" was assigned to status.

Trends – Due to differences in mapping resolution and evaluation approaches for this indicator over time, there was "low" confidence assigned to trend.

Overall Confidence – Confidence assigned to status was "moderate" and to trend "low." Therefore, overall confidence was assigned a "low" determination for each elevation zone.

Interim Target – Demonstrate a measureable increase in the percent cover of stands dominated by large diameter (>24" dbh) conifer trees within the forested landscape for each of the elevation zones by the next evaluation (2016).

Target Attainment Date – Attainment of the interim target is expected to occur by 2016. However, attainment of the Threshold Standard could take up to 75 years based on growth characteristics of conifers in the Lake Tahoe Basin (Safford, personal communication, 2010).

Human & Environmental Drivers – Soil conditions, aspect, hill slope position, drought frequency, direct sunlight, fire suppression, climate patterns, time and natural disturbance influence the extent and distribution of large-diameter trees (Collins et al. 2011; Beardsley et al. 1999; Beaty and Taylor 2007; Scholl and Taylor 2006; USDA 2000). Historical land uses, such as clear-cut logging in the late 1800s, dramatically reduced the overall extent of old growth forests in the Basin (USDA 2000). Current forest management has emphasized thinning of overstocked conifer stands, which could result in faster growth rates due to less competition for resources (D. Fournier, personal communication, 2011; USDA 2011d).

Monitoring Approach – Every five years, the Tahoe vegetation map is updated with new satellite data (if available) and/or modeled and calibrated using field-based Forest Inventory and Analysis (FIA) data to assess the extent of different vegetation types and associated forest structure characteristics for the Basin (USDA 2009c; Warbington et al. [no date]). For this analysis, CWHR vegetation types associated with large-diameter trees were queried and enumerated from the most recently available vegetation map (U.S. Forest Service - Remote Sensing Lab Pacific Southwest Region: TMU_Strata_07 [published 2009]).

Monitoring Partners – U.S. Forest Service, US Geological Survey and Tahoe Regional Planning Agency

Programs and Actions Implemented to Improve Conditions – TRPA has adopted several policies and ordinances designed to promote the conservation and protection of old growth forests (TRPA 1986; TRPA 1987a as amended in 2012). Agency partners (such as California Tahoe Conservancy, California State Parks, Nevada Division of Forestry and U.S. Forest Service) affiliated with the Environmental Improvement Program (EIP) have implemented numerous forest restoration and enhancement projects, mostly to thin overstocked conifer stands to reduce the potential for catastrophic wildfire and restore conifer tree densities

consistent with historical conditions. These projects are expected to facilitate growth of remaining trees into size classes consistent with achieving Threshold Standards for old growth forests (D. Fournier, personal communication, 2011; USDA 2011d).

Effectiveness of Programs and Actions – Current regulations appear appropriate and sufficiently flexible to protect late seral and old growth forest ecosystems. Forest fuels reduction projects implemented through the EIP have treated more than 45,000 acres of conifer forests and are expected to contribute to the achievement of the Late Seral and Old Growth Forest Ecosystems Threshold Standard.

Recommendations for Additional Actions – This evaluation has demonstrated that the current approach to quantifying status and trend of this indicator is problematic because of different mapping approaches and interpretations of what constitutes "Late Seral and Old Growth Forest Ecosystems." TRPA must clearly and quantitatively define its Threshold Standards and all of the steps necessary to generate information to be able to credibly assess progress toward meeting the targets. Another concern with the Late Seral and Old Growth Forest Ecosystems analysis is the acreage of late seral and old growth forest set as the Threshold Standard. It seems likely that the Montane and Upper Montane Threshold Standards are achievable and reasonable, but the mapping results for Subalpine late seral and old growth forest stands cast doubt on the ability to attain the Threshold Standard for higher elevations when interpreted to achieve stands dominated by trees > 24" dbh. Subalpine forests in the Basin have been only slightly (if at all) affected by human activity (e.g., land management, logging, or fire suppression); the assumption is that conditions in these stands are very similar to conditions before Euro-American settlement. Even the map used for the 2006 Threshold Evaluation of old growth forests, which is quite liberal in its estimate, shows less than half the acreage of Subalpine late seral and old growth forest than is called for in the standard. If conditions in the Subalpine zone have barely changed over the last century in the face of little human intervention, then the Threshold Standard is simply too high, and not achievable. Trees grow very slowly in the Subalpine zone, and even an 18" dbh tree can be very old (up to 200 years old). Since mature trees in the Subalpine zone are often smaller than 24" dbh or 30" dbh, the Threshold Standard interpretation for that zone should be adjusted to more accurately reflect the mature state of species occurring in that zone.

Uncommon Plant Communities

The Lake Tahoe Basin supports a wide range of plant community types and conditions. Recent maps of existing vegetation have identified over 60 discrete vegetation types. Forest and shrubs account for the majority of the classified types and occupy the majority of the landscape. Herbaceous plant communities associated with water comprise the most rare types, including meadows, marshes, fens, riparian areas and the deep-water plants of Lake Tahoe. Fens in particular are among the most rare and sensitive habitat types in the Sierra Nevada. Along with the high elevation cushion plant community, these uncommon plant communities are biological hotspots that contribute substantially to the biological richness, productivity, and ecological services of the entire Region. Wetland vegetation, for example, plays an important role in recycling nutrients, trapping eroding soil, and filtering out pollutants. Wetland filtration capacity is critically important in protecting Lake Tahoe's water quality.

TRPA policy is to conserve uncommon plant communities and "provide for the non-degradation of their natural qualities." The natural qualities of a plant community include the current plant species assemblage, the health, age and ecological condition of those plant species, and the condition of the hydrologic regime. This Threshold Standard has been applied to eight specific vegetative communities including the Grass Lake fen, Osgood Swamp, Freel Peak cushion plants, Hell Hole fen, Upper Truckee Marsh, Taylor Creek Marsh, Pope Marsh, and deep-water plants. The natural qualities of these communities have not been defined, and attainment status is based on "the determination of a qualified expert." As such, the present status and trend determinations for each of the uncommon plant communities are based primarily on a qualitative assessment of known recreation impacts, management actions, and knowledge of general vegetation and hydrologic conditions. Figure 6-3 summarizes the status of each of the sites listed in the Uncommon Plant Communities Indicator Reporting Category. Due to insufficient data, an evaluation for deep-water plant communities was not conducted and its current status is "unknown."

Indicators for four of the seven plant communities are "at or better than target," while three are "slightly worse than target" (Figure 6-3). Of the three Marsh communities, only Taylor Creek Marsh is "in attainment." Upper Truckee Marsh and Pope Marsh are located in the urban core, and associated urban run-off, hydrologic modifications, and invasive plant infestations suggest that the natural qualities of these two communities are less intact than more remote wetlands, and that the threshold condition is "slightly worse than target" at these sites.

A quantitative system for ranking the ecological integrity and quality of fens in the Sierra Nevada has recently become available, and was used to assess the status of the three fens (Grass Lake, Osgood Swamp, and Hell Hole). In the 2010 Lake Tahoe Basin Fen Assessment, a fen ranking system (Sikes et al. 2011) was used in which a numeric Conservation Significance Rank can be calculated for a fen, based on the sum of scores for each of eight different criteria. Using that method, Grass Lake and Hell Hole received moderately high and high scores, respectively, which supported the qualitative assessment that these sites are in attainment. Although Osgood Swamp received a high Conservation Significance rank, the status of the Threshold Standard was assessed as "slightly worse than target" because beaver (*Castor canadensis*) impacts on hydrology were not adequately considered in the ranking system. The indicator for the Freel Peak cushion plant community is "at or better than target."

The adopted Threshold Standard explicitly states that the threshold shall not be limited to the listed communities. Therefore, it is recommended that the Threshold Standard be changed from "Uncommon Plant Communities," to "Plant Communities of Concern," and that the Threshold

Standard applies to the broader vegetation types of 1) fen, 2) marsh, 3) meadow, and 4) cushion plants. The U.S. Forest Service has recently established two long-term vegetation monitoring programs that would allow the Uncommon Plant Communities Threshold Standard to be more inclusive. The U.S. Forest Service, Region 5 Fen Assessment program identified a total of 135 potential fens within the Lake Tahoe Basin and since 2006, a total of 47 of the 135 locations have been confirmed as fens.

The quantitative Conservation Significance ranking system is being used to prioritize fens for long-term monitoring to detect change in fen condition over time. Beginning in 2004, long-term monitoring plots have been established in 36 meadows and marshes located throughout the Tahoe Basin as part of the U.S. Forest Service, Region 5 Range Monitoring Program. The program is designed to quantify changes in the ecological condition of wetland plant communities. Ecological conditions of low, moderate, or high are assigned based on plant species composition, the presence of different plant functional groups, and other hydrogeomorphic variables.

These programs will enable the adoption of quantitative indicators for fens, meadows, and marshes. Long-term monitoring plots that have been installed on Freel Peak in the cushion plant community, will enable quantitative indicators to be developed for that unique community type.

Monitoring data on the deep-water plants of Lake Tahoe is extremely limited. Since the 1960s, only one survey has occurred in 2008-2009 and the results from that effort have yet to be published. Although this recent survey mainly focused on deep-water insects rather than the deep-water plant community, the biomass of plant material was noted for each sample collected during the survey. The preliminary results of this effort indicate a dramatic decline in Lake Tahoe's deep-water plant community when compared to surveys conducted in the 1960s (A. Caires, personal communication). However, the lack of long-term monitoring data make interpretation of the plant community's status and trend extremely challenging because limited data exists from only two surveys, and little is known about the plant community's natural variation or life history characteristics. Consequently, it is recommended that additional research and monitoring be conducted to increase our knowledge of the deep-water plant community. Once published, the results of the recent surveys will be incorporated into future TRPA reporting efforts.

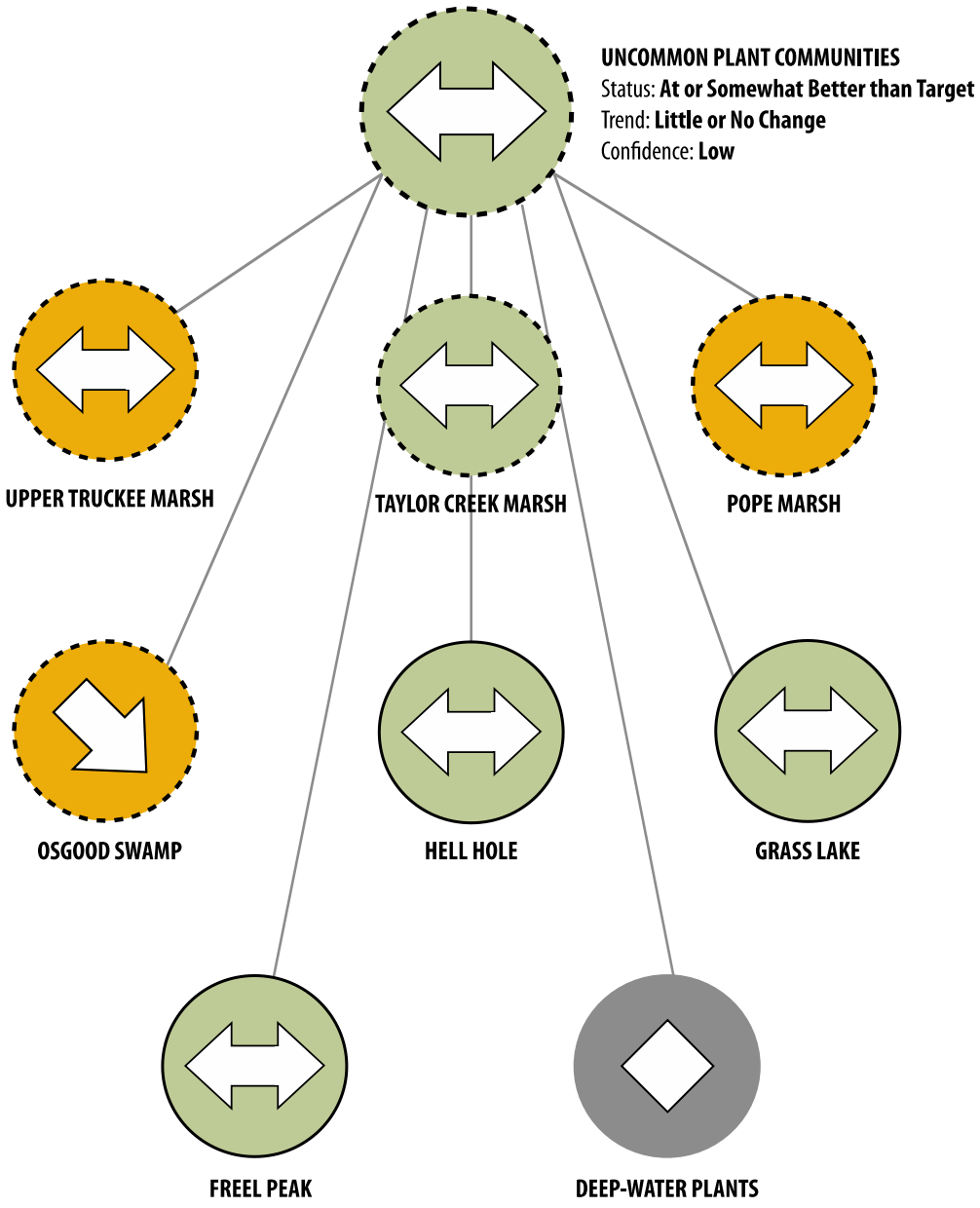
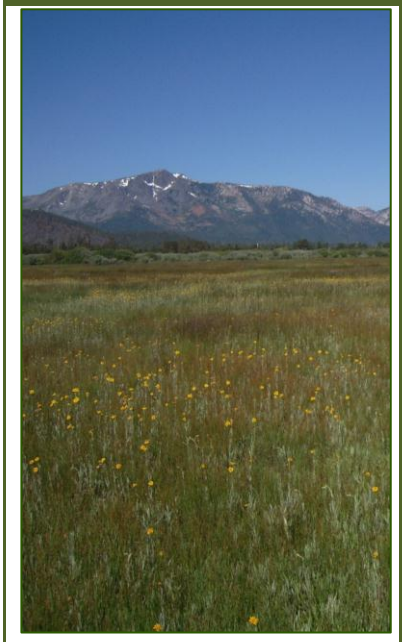


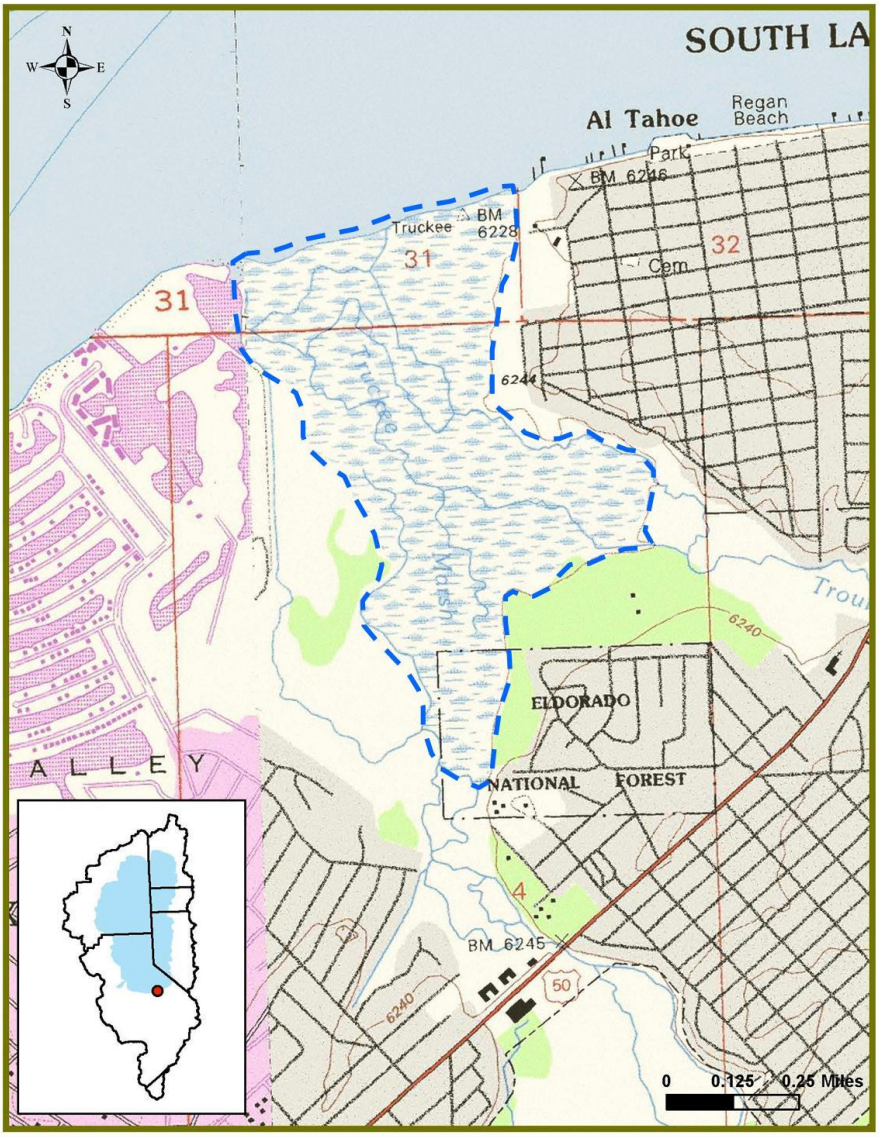
Figure 6-3. *Reporting icons for the eight indicators evaluated in the Uncommon Plant Communities Indicator Reporting Category. Results from each of the eight indicators (bottom) were evaluated and aggregated to characterize the overall status of the Uncommon Plant Communities Indicator Reporting Category (top).*

Uncommon Plant Communities: **Upper Truckee Marsh**

Reporting Icon	Map
UPPER TRUCKEE MARSH Status: **Somewhat Worse than Target** Trend: **Little or No Change** Confidence: **Low**	Map showing location of Upper Truckee Marsh and surrounding area.

Photo





Data Evaluation and Interpretation

Relevance – Located within the City of South Lake Tahoe, the Upper Truckee Marsh is the single largest wetland in the Sierra Nevada, occupying over 1,300 acres (Manley et al. 2000). Development of the Tahoe Keys in the 1960s reduced the area of the wetland to less than half of its former size and more directly channeled the path of the Upper Truckee River to Lake Tahoe (Manley et al. 2000). Despite this development, the marsh is still the largest in the region, and this unique ecosystem provides important habitat for numerous plant, animal, and invertebrate species, including some that depend on the marsh for their entire life cycle (Manley et al. 2009). Extensive sandy beach deposits at the margin of Lake Tahoe support a robust population of the endangered Tahoe yellow cress (*Rorippa subumbellata*), which is a TRPA listed sensitive plant species (Stanton and Pavlik 2005-2010). Freshwater marshes are one of the most productive ecosystems in the Tahoe Basin, and have been identified in the Tahoe Science Plan (Hymanson and Collopy 2010) as special communities, which are small in extent but have great functional importance (Manley et al. 2009). The Upper Truckee River drains the largest watershed in the Lake Tahoe Basin, and the wetland vegetation in the marsh plays an important role in recycling nutrients, trapping eroding soil, and filtering pollutants (Martin

and Chambers 2004). Still, the Upper Truckee River is the single largest source of suspended sediment entering Lake Tahoe (Lahontan and NDEP, 2010). Retention of existing vegetation in the remaining marsh area is important for conservation of wildlife habitat and enhancement of water quality (Manley et al. 2009).

Threshold Category – Vegetation

Indicator Reporting Category – Uncommon Plant Communities

Adopted Standard – Provide for the non-degradation of the natural qualities of any plant community that is uncommon to the Basin or of exceptional scientific, ecological, or scenic value. The Threshold Standard shall apply, but not be limited to, 1) deep-water plants of Lake Tahoe, 2) Grass Lake, 3) Osgood Swamp, 4) Hell Hole, 5) Upper Truckee Marsh, 6) Taylor Creek Marsh, 7) Freel Peak Cushion Plant Community, and 8) Pope Marsh.

Type of Standard – Numerical (without adopted targets)

Indicator (Unit of Measure) – The status and trend determination was based on a qualitative assessment of the natural qualities of a plant community. The natural qualities of a plant community include the current plant species assemblage, the health, age, and ecological condition of those plant species, and the condition of the hydrologic regime.

Status – The Upper Truckee Marsh is one of the most unique and productive ecosystems in the Lake Tahoe Basin. Its condition depends directly on the proper functioning of the Upper Truckee River and the health of the surrounding watershed. The majority of the marsh is actively managed by the California Tahoe Conservancy (CTC) to maintain and improve the conditions of natural resources, including plant communities. Substantial alteration of the watershed over the past 150 years has caused erosion along the banks of the Upper Truckee River and led to channel incision and increased sediment transport and nutrient loads into Lake Tahoe (Manley et al. 2009). Although increased sediment load from streams contributes to reduced clarity in the Lake, the cumulative effect this has had on the vegetation community in the marsh is not well known. The Upper Truckee River inundates the floodplain less often since being more directly channelized, which deprives the wetland vegetation of needed sediment and nutrients. The incised channel has also lowered groundwater levels and desiccated riparian and meadow vegetation. In addition, heavy grazing in the past may have substantially altered the composition of plant and animal communities within the marsh. These cumulative impacts have compromised the hydrologic integrity of the Upper Truckee River ecosystem and degraded the natural qualities of the marsh (Manley et al. 2000). Because the hydrologic function of the marsh has been degraded, it is thought that the 2006 Threshold Evaluation ranked the status of the Upper Truckee Marsh too high when it described it as being in attainment. Although it is not possible to assess the degree of degradation without quantitative data regarding desired reference conditions or the existing vegetative community, it is evident that the marsh has not achieved its desired condition. Therefore, the status of Upper Truckee Marsh is considered to be "somewhat worse than target."

Trend – The 2006 Threshold Evaluation considered the Upper Truckee Marsh to be in attainment, whereas this evaluation has determined it to be "somewhat worse than target." The reduced status in this evaluation is based primarily on the location of the Upper Truckee Marsh in the urban core, and its compromised hydrological condition. However, there is no quantitative evidence available indicating there has been any particular decline in the condition of the marsh over the last five years; in fact, many of the management actions implemented by the CTC are expected to improve conditions in the Marsh. Due to the lack of quantitative evidence indicating an improvement or decline in the condition of the Upper Truckee Marsh, the trend was assessed as "little or no change."

Confidence – Confidence in the status and trend analysis is "low" because both determinations were based on a qualitative assessment of the hydrological condition, resource management actions, and surrounding land uses, and was not supported by sufficient quantitative data.

Interim Target – It is not possible to set a numerical interim target until additional monitoring data is available to gage the status and trend of the site.

Target Attainment Date – It will be possible to set a target attainment date after additional monitoring data is collected and analyzed. Planned restoration of the Upper Truckee Marsh (500 acres) suggests this site should be in attainment after restoration efforts are completed and the marsh is allowed time to recover.

Human & Environmental Drivers – The Upper Truckee Marsh lies within the largest and most heavily developed watershed in the Basin. A legacy of clear-cutting, heavy grazing, modification and diversion of the Upper Truckee River, and urban development directly within the marsh have shaped the current vegetative community in the Upper Truckee Marsh. Marsh communities are tightly linked with water table attributes and soil water chemistry (Allen-Diaz 1991). Urban runoff and pollution can alter water chemistry and affect vegetation composition. Historical channel and floodplain manipulations lower the water table, and result in a drier marsh that supports a different plant community. Recreational activities can result in soil compaction, stream bank erosion, trampling of plants, disturbance of wildlife, and introduction of invasive species. As with other wetlands, extended drought and climate change pose a threat to the system.

Monitoring Approach – The status and trend determinations were based on a qualitative assessment of factors influencing the condition of the site, including historical alterations, on-going hydrologic impacts, sources of recreation-related disturbance, and surrounding land use and management. Vegetation monitoring is performed by the CTC to identify management needs or assess the effectiveness of planned or completed restoration efforts, but it does not yet provide information useful in assessing long-term

changes in the natural qualities of the plant community. Monitoring efforts include annual surveys for invasive species, plant community mapping, floodplain biomass monitoring, and monitoring of hydrologic properties that affect plant communities such as ground water levels and river channel capacity. Much of the monitoring data provides baseline conditions for factors that are expected to change after implementation of a large restoration project at the site. This information is expected to better inform future evaluations of the Threshold Standard at the marsh.

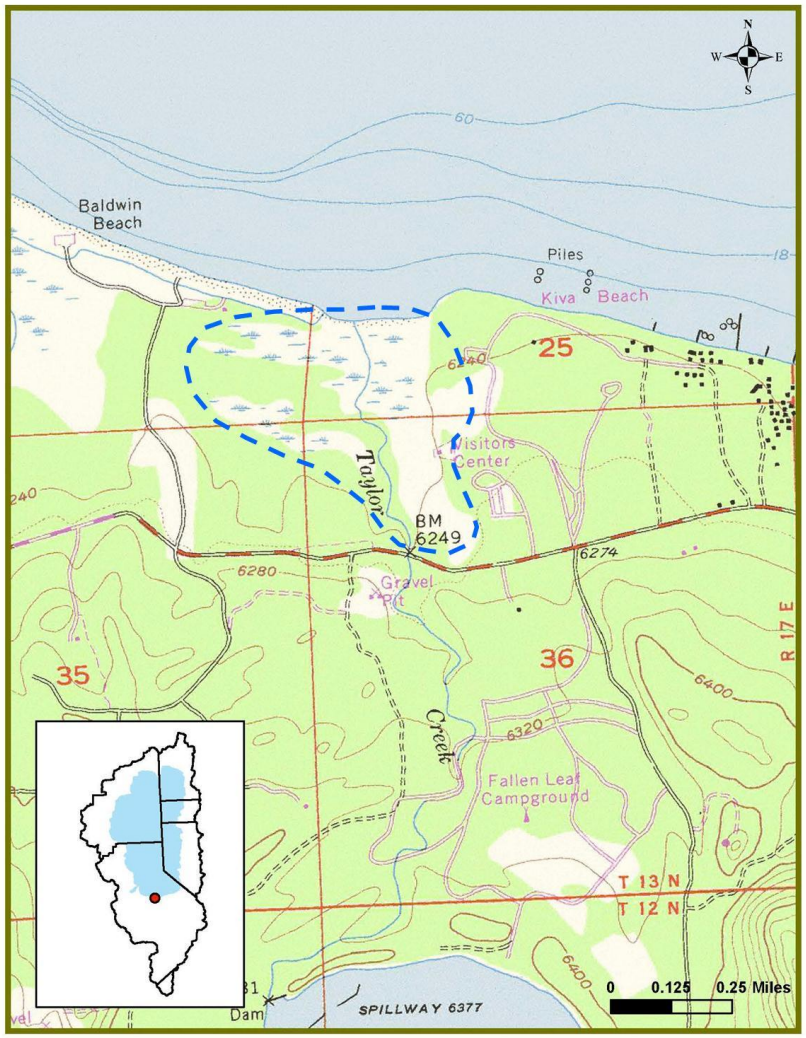
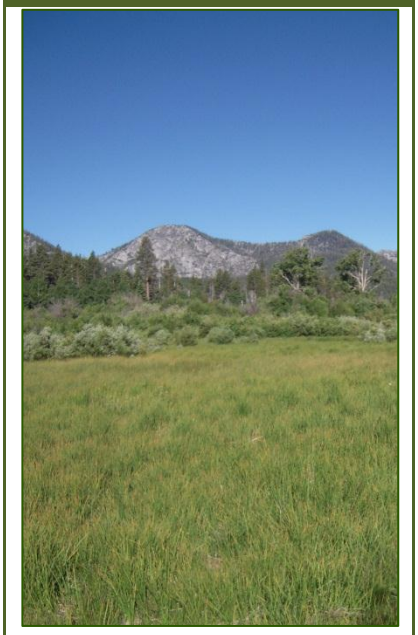
Monitoring Partners – California Tahoe Conservancy

Programs and Actions Implemented to Improve Conditions – The TRPA currently implements regulations related to the protection of stream environment zones and uncommon plant communities. Anthropogenic activities known to impact these areas are prohibited. The CTC acquired over 500 acres of the marsh in 2000, eliminated grazing, and installed a beach enclosure for Tahoe yellow cress. Beginning in 2002, the CTC has had an Upper Truckee Marsh land steward on patrol in the summer months to educate users about the sensitive resources in the marsh; encouraging users to observe the Tahoe yellow cress enclosure, remaining on the main trails of the property, and advising users to keep their dogs leashed at all times. A seasonal dog ban on over 300 acres of the marsh from May 1 through July 31 was initiated in 2011 to protect wildlife and water quality during spring runoff. In 2010, encroaching conifers were removed from a portion of the marsh. In addition to these actions, a partnership of federal, state, and local agencies is coordinating restoration efforts for the Upper Truckee River. The multiphase approach includes a series of six distinct, but adjacent projects, that each focus on restoration of a particular reach of the Upper Truckee River. The goal is to restore natural processes and functions in order to improve water quality, terrestrial and aquatic habitat, and native vegetation. In 2011, the first reach was completed near the South Lake Tahoe Airport. Five alternatives for the restoration of the Upper Truckee Marsh, which would restore natural processes to support this uncommon plant community, are currently being evaluated.

Effectiveness of Programs and Actions – The removal of grazing would likely benefit the vegetation in the Upper Truckee Marsh, but quantitative data are not available. The Land Steward Program has been effective in increasing dog leash compliance and reducing incursions into sensitive areas, including the Tahoe yellow cress enclosure. More time and data are needed to objectively evaluate the effectiveness of other actions that have been implemented.

Recommendation for Additional Actions – The recommendation is to install permanent long-term vegetation monitoring plots following the protocol of the U.S. Forest Service – Region 5 Range Monitoring Program. This monitoring approach is being used at the other wetland uncommon plant community sites listed by TRPA, to quantify changes in the ecological condition. Adoption of this approach will streamline future Threshold Evaluations and allow comparison among the sites. The protocol is designed to classify a meadow according to dominant plant species, elevation, and site moisture characteristics, and then use a quantitative ecological condition scorecard for that meadow type. The user assigns an ecological condition of low, moderate, or high based on plant species composition, the presence of different plant functional groups, and other hydrogeomorphic variables. The protocol provides information on the environmental conditions necessary to support certain rare species, and the monitoring design allows for quantitatively tracking rare species abundance.

Uncommon Plant Communities: **Taylor Creek Marsh**

Reporting Icon	Map
TAYLOR CREEK MARSH Status: **At or Better than Target** Trend: **Little or No Change** Confidence: **Low**	
Photo	
	Map showing location of Taylor Creek Marsh and surrounding area.

Data Evaluation and Interpretation

Relevance – Taylor Creek Marsh covers more than 250 acres adjacent to U.S. Forest Service Baldwin Beach and Kiva Beach on the south shore of Lake Tahoe. The marsh complex includes the drainage areas of both Taylor and Tallac Creeks, and the mouths of both creeks support robust populations of the endangered Tahoe yellow cress (*Rorippa subumbellata*), a TRPA listed sensitive plant species (Stanton and Pavlik 2005-2010). Taylor Creek Marsh provides important waterfowl nesting habitat, habitat for bald eagles, and supports a multitude of other species, including some that depend on the marsh for their entire life cycle (Manley et al. 2000). Freshwater marshes are one of the most productive ecosystems in the Basin and have been identified in the Tahoe Science Plan (Hymanson and Collopy 2010) as special communities, which are small in extent, but have great functional importance (Manley et al. 2009). Wetland vegetation plays an important role in recycling nutrients, trapping eroding soil, and filtering pollutants (Manley et al. 2009). This filtration capacity critically important in protecting the clarity of Lake Tahoe.

Threshold Category – Vegetation

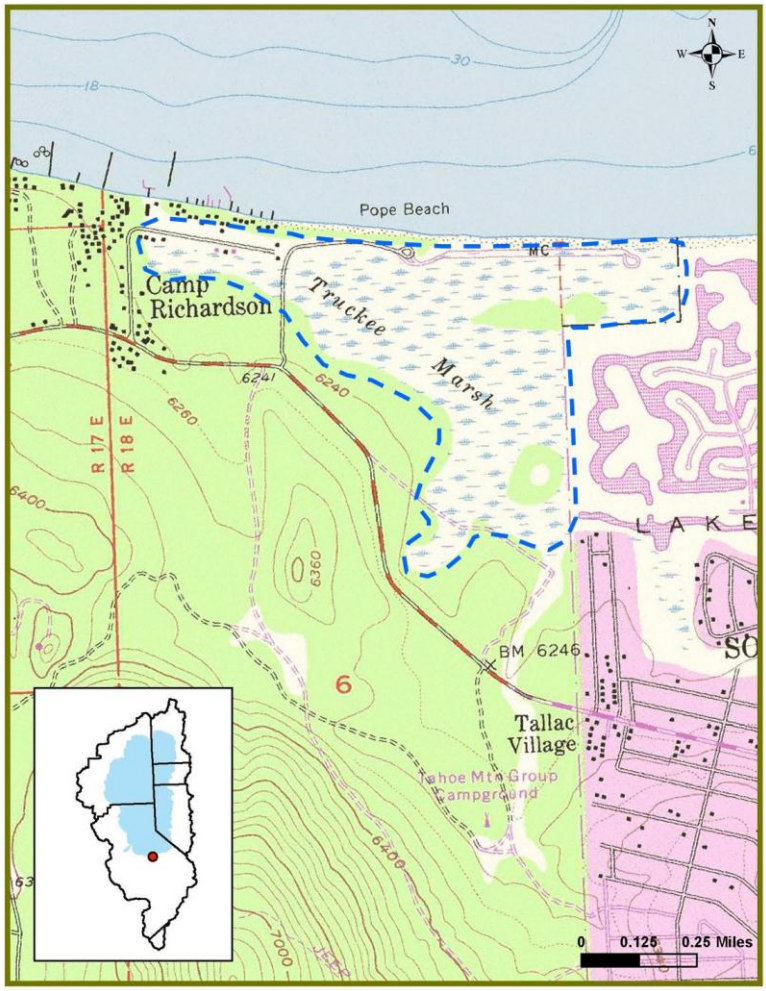
Indicator Category – Uncommon Plant Communities

Adopted Standards – Provide for the non-degradation of the natural qualities of any plant community that are uncommon to the Basin, or of exceptional scientific, ecological, or scenic value. The Threshold Standard shall apply, but not be limited to, 1) the deep-water plants of Lake Tahoe, 2) Grass Lake, 3) Osgood Swamp, 4) Hell Hole, 5) Upper Truckee Marsh, 6) Taylor

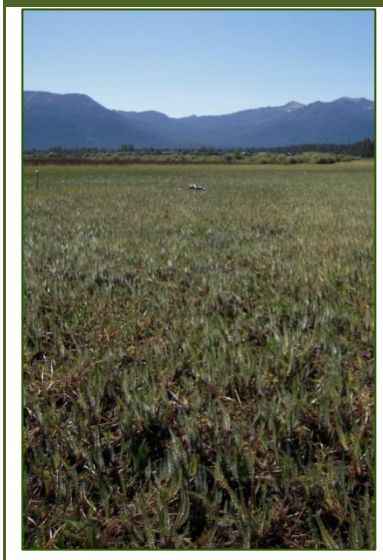
Creek Marsh, 7) Freel Peak Cushion Plan Community, and 8) Pope Marsh.
Type of Standard – Numerical (without adopted targets)
Indicator (Unit of Measure) – The status and trend determination was based on a qualitative assessment of the natural qualities of a plant community. The natural qualities of a plant community include the current plant species assemblage, the health, age and ecological condition of those plant species, and the condition of the hydrologic regime.
Status – Taylor Creek Marsh is adjacent to Baldwin Beach and Kiva Beach, which are largely undeveloped, but receive moderate to high levels of recreational use in the summer months. Most of the use is concentrated on the beaches themselves and the area around the U.S. Forest Service Taylor Creek Visitor Center east of the marsh. The Visitor Center includes a paved trail through the marsh, numerous user trails, and a stream profile viewing chamber on Taylor Creek. A road to the beach parking lots bisects the entire complex. A fire burned through a portion of the site in 2002 and the burned area has since supported one of the largest infestations of invasive bull thistle (*Cirsium vulgare*) on National Forest lands in the Lake Tahoe Basin (USDA 2011a). St. John's wort, (*Hypericum perforatum*), another noxious weed species, has also established in wetter unburned areas, and invasive Eurasian watermilfoil (*Myriophyllum spicatum*) is found in the mouths of both Taylor and Tallac Creeks (USDA 2011a). The Forest Service is monitoring these infestations and removing bull thistle and St John's wort by hand when possible. Dogs, which may harass wildlife, trample vegetation, and add unwanted nutrients to the system, are prohibited at Baldwin Beach, but allowed on leash at areas accessed by the Taylor Creek Visitor Center. Approximately 150 acres within and adjacent to the site were treated for fuels reduction, including the entire burned area (USDA 2011b). Along the beach, portions of the Tahoe yellow cress populations have been fenced, beginning as early as the 1980s and these enclosures have continually supported robust numbers of plants (Stanton et al. 2010). Quantitative vegetation monitoring plots have been installed at the site, but the data has not yet been evaluated (Engelhardt and Gross 2011a). Recent Threshold Evaluations have judged that the status of Taylor Creek Marsh is in attainment and stable (TRPA 2001; TRPA 2011c). Management actions to control invasive weed spread, direct recreational use, and reduce fuel loads, fire risk, and hazardous dead trees have been implemented. Still, there are impacts from recreation in limited portions of the marsh complex. The beach at the outlet of the marsh continues to support Tahoe yellow cress. There is no evidence that the plant communities in the area have declined in the last five years, and therefore, Taylor Creek Marsh was determined to be "at or better than target."
Trend – There is no evidence available indicating there has been any particular decline or improvement in the condition of Taylor Creek Marsh over the last five years. No major changes have been observed in the management approach, or the amount, type, or location of recreational use, that would affect the natural qualities of the site. Therefore, the trend was assessed as "little or no change."
Confidence – The confidence in the status and trend analysis was determined to be "low," because insufficient quantitative data were available to judge status and trend.
Interim Target – None, the Threshold Standard is in attainment.
Target Attainment Date – None, the Threshold Standard is in attainment.
Human & Environmental Drivers – Recreation impacts from user-created trails and dogs in the vicinity of the Taylor Creek Visitor Center at Taylor Creek Marsh exist and are not likely to be removed in the future (Engelhardt and Gross 2011a). However, the site is not subject to any of the main activities that generally threaten wetlands in the Sierra Nevada including road and trail construction, stock trampling, off-road vehicles, and ground and surface water pumping, although water pollution from the state highway may be a concern (Manley et al. 2000). Lake level, stream flow, and shoreline processes interact in conjunction with wave action to dictate the opening and closing of the sandbars across the mouth of Taylor and Tallac Creeks. In low water years, the barrier beach is sometimes breached (i.e., artificially opened) to facilitate kokanee salmon spawning in late summer and fall. Water availability and soil moisture in the marsh determines which plant species can persist and thrive (USDA 2009d). Similar to other wetlands, extended drought and climate change pose a threat to the system.
Monitoring Approach – The status and trend determinations were based on a qualitative assessment of factors influencing the condition of the site including historical alterations, on-going hydrologic impacts, sources of recreation-related disturbance, and surrounding land use and management. However, in the future it will be possible to base the evaluation on quantitative vegetation monitoring data. Permanent plots following the protocol in the Region 5 Range Monitoring Program were installed at Taylor Creek Marsh in 2004 (Weixelman et al. 2003). The program is designed to quantify changes in the ecological condition of wetland plant communities (Weixelman et al. 2003). The plots were re-visited in 2009/2010 but the data have not yet been analyzed (Engelhardt et al. 2011). The protocol is designed to classify meadows and wetlands according to dominant plant species, elevation, and site moisture characteristics, and then use a customized quantitative ecological condition scorecard for that meadow type. The user assigns an ecological condition of low, moderate, or high based on plant species composition, the presence of different plant functional groups, and other hydrogeomorphic variables. The protocol provides information on the environmental conditions necessary to support certain rare species, and the monitoring design allows for quantitatively tracking rare species abundance.
Monitoring Partners – U.S. Forest Service Lake Tahoe Basin Management Unit, California Native Plant Society
Programs and Actions Implemented to Improve Conditions – The TRPA currently implements regulations related to the

protection of stream environment zones and uncommon plant communities. Anthropogenic activities known to impact these areas are prohibited.
Effectiveness of Programs and Actions – Current regulations and protection measures appear effective. Continuing efforts to control noxious weeds are needed.
Recommendation for Additional Actions – Document and adopt procedures for long-term monitoring of this site to quantitatively and objectively assess conditions over time.

Uncommon Plant Communities: **Pope Marsh**

Reporting Icon	Map
POPE MARSH Status: **Somewhat Worse than Target** Trend: **Little or No Change** Confidence: **Low**	 Map showing location of Pope Marsh and surrounding area.

Photo



Data Evaluation and Interpretation

Relevance – Pope Marsh, managed by U.S. Forest Service – LTBMU, occupies roughly 150 acres adjacent to the City of South Lake Tahoe. It was formerly part of the wetland complex at the mouth of the Upper Truckee River, but development of the Tahoe Keys in the 1960s isolated Pope Marsh from the Upper Truckee River and dramatically reduced the size of what was the largest freshwater marsh and meadow complex in the Sierra Nevada (Manley et al. 2000). Pope Marsh is now dependent primarily on rain, snowmelt, and underground flow from Lake Tahoe for its water (Green 1991). Meadows, marshes, and fens have been identified in the Tahoe Science Plan (Hymanson and Collopy 2010) as special communities that are small in extent, but have great functional importance (Manley et al. 2009). Wetland vegetation plays an important role in recycling nutrients, trapping eroding soil, and filtering pollutants (Manley et al. 2000). This filtration capacity is critically important to protect the clarity of Lake Tahoe. Pope Marsh also provides important habitat for numerous species, including waterfowl nesting habitat.

Threshold Category – Vegetation

Indicator Reporting Category – Uncommon Plant Communities

Adopted Standards – Provide for the non-degradation of the natural qualities of any plant community that is uncommon to the Basin or of exceptional scientific, ecological, or scenic value. The Threshold Standard shall apply, but not be limited to, 1) the deep-water plants of Lake Tahoe, 2) Grass Lake, 3) Osgood Swamp, 4) Hell Hole, 5) Upper Truckee Marsh, 6) Taylor Creek Marsh, 7) Freel Peak Cushion Plan Community, and 8) Pope Marsh.

Type of Standard – Numerical (without adopted targets)

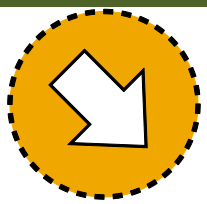
Indicator (Unit of Measure) – The status and trend determination was based on a qualitative assessment of the natural qualities of a plant community. The natural qualities of a plant community include the current plant species assemblage, the health, age and ecological condition of those plant species, and the condition of the hydrologic regime.
Status – Pope Marsh is adjacent to Pope Beach, which is one of the most heavily used public recreation facilities at Lake Tahoe in the summer months. Most of the use is concentrated on the beach itself, but a long parking lot separates Pope Marsh from Lake Tahoe, and culverts connect the beach area to the marsh. The main impacts to the marsh are related to recreation; including disturbance of vegetation and wildlife by dogs, and some trampling from hiking and bicycling. A relatively large infestation of bull thistle (*Cirsium vulgare*) has been present at Pope Marsh for several years, and Eurasian watermilfoil (*Myriophyllum spicatum*) occurs in the standing water (USDA 2011a). Groundwater pumping from the Tahoe Keys potentially poses a threat to the hydrologic regime, and is likely leading to a gradual change in species composition (Green 1991; EPA 2000).

Despite the adverse impacts to the area, recent Threshold Evaluations have assessed the status of Pope Marsh as in attainment, although the potential for decline was noted (TRPA 2007c). Management actions in the last five years have focused on facility improvements, hazard tree removal at Pope Beach, and control of known invasive plant populations at Pope Marsh (USDA 2011a). In 2007, the Angora Fire burned 3,000 acres within the sub-watershed that drains into Pope Marsh. Data collected following the fire suggests the fire had a negligible effect on lake clarity and algal biomass (TERC 2011a). Many erosion control and restoration projects have been implemented in the burn area, and it may be reasonable to conclude that the fire also had a negligible effect on Pope Marsh itself. However, the location of the wetland in the urban core, and the associated urban run-off and invasive plant infestations suggest that the natural qualities of Pope Marsh are not as intact as more remote wetlands like Hell Hole or Meiss Meadows. Most importantly, groundwater pumping from the Tahoe Keys is an on-going threat to the integrity of the marsh plant community (EPA 2000). Therefore, the status of Pope Marsh was assessed as "somewhat worse than target."
Trend – Although the previous Threshold Evaluation considered Pope Marsh to be in attainment, and here it was assessed as "somewhat worse than target," there is no evidence available to indicate there has been any particular decline in the last five years. The decline in the status in the present evaluation is based primarily on the location of Pope Marsh in the urban core, the on-going groundwater pumping from the Tahoe Keys, and the compromised hydrologic condition compared to marshes in remote areas. Therefore, the trend in the condition of Pope Marsh was considered to be "little or no change."
Confidence – The confidence in the status and trend analysis was "low," because both determinations were based on a qualitative assessment, and are not supported by sufficient quantitative data.
Interim Target – It will not be possible to set a numerical interim target condition until the quantitative vegetation monitoring data is analyzed. The outcome of that analysis will be a designation of an ecological condition of low, moderate, or high. The target will be to improve the ecological condition rating of Pope Marsh unless the rating is high, in which case the target will be to maintain the condition of the marsh.
Target Attainment Date – It will be possible to set a target attainment date after the quantitative vegetation monitoring data has been analyzed.
Human & Environmental Drivers – Pope Marsh was irreversibly altered by the development of the Tahoe Keys (Manley et al. 2000). Since then, human activities outside of the marsh (e.g., groundwater pumping, development, and management of lake water levels) impact the hydrology within the marsh (EPA 2000). These anthropogenic stresses on Pope Marsh increase sensitivity to naturally occurring stressors, and likely will initiate gradual changes in the plant community composition of the marsh, which could dramatically change the effectiveness of the marsh as a filter of nutrients and sediments (EPA 2000). Other human impacts include the introduction of invasive plants, dogs, and some trampling from hiking and bicycling. As with other wetlands, extended drought and climate change pose a threat to the system.
Monitoring Approach – The status and trend determinations were based on a qualitative assessment of factors influencing the condition of the site, including historical alterations, on-going hydrologic impacts, sources of recreation-related disturbance, and surrounding land use and resource management. However, in the future it will be possible to base the evaluation on quantitative vegetation monitoring data. Permanent plots following the protocol in the Region 5 Range Monitoring Program were installed at Pope Marsh in 2004 (Weixelman et al. 2003). The plots were re-visited in 2009/2010, but the data have not yet been analyzed (Engelhardt and Gross 2011). The program is designed to quantify changes in the ecological condition of wetland plant communities. The protocol is designed to classify meadows and wetlands according to dominant plant species, elevation, and site moisture characteristics, and then use a quantitative ecological condition scorecard for that meadow type. The user assigns an ecological condition of low, moderate, or high based on plant species composition, the presence of different plant functional groups, and other hydrogeomorphic variables. The protocol also provides information on the environmental conditions necessary to support certain rare species, and the monitoring design allows for quantitatively tracking rare species abundance.
Monitoring Partners – U.S. Forest Service Lake Tahoe Basin Management Unit, California Native Plant Society
Programs and Actions Implemented to Improve Conditions – TRPA currently implements regulations related to the protection of stream environment zones and uncommon plant communities. Anthropogenic activities known to impact these areas are prohibited.
Effectiveness of Programs and Actions – Current regulations and protection measures appear effective. However, additional

efforts are needed to control noxious and aquatic weed infestations.
Recommendation for Additional Actions – Document and adopt procedures for long-term monitoring of this site to quantitatively and objectively assess conditions over time. Continue efforts to control known weed infestations and prevent new infestations.

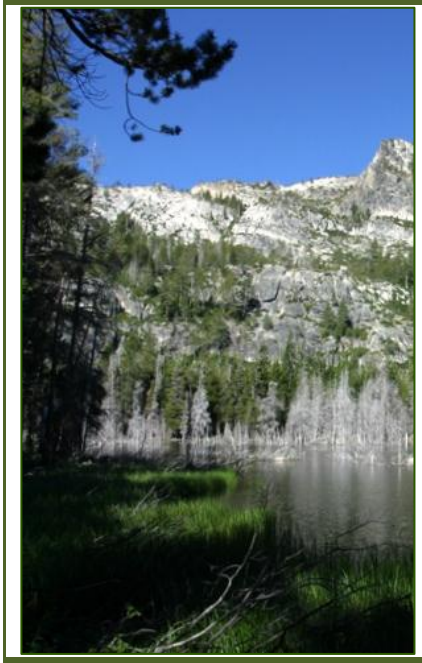
Uncommon Plant Communities: **Osgood Swamp**

Reporting Icon

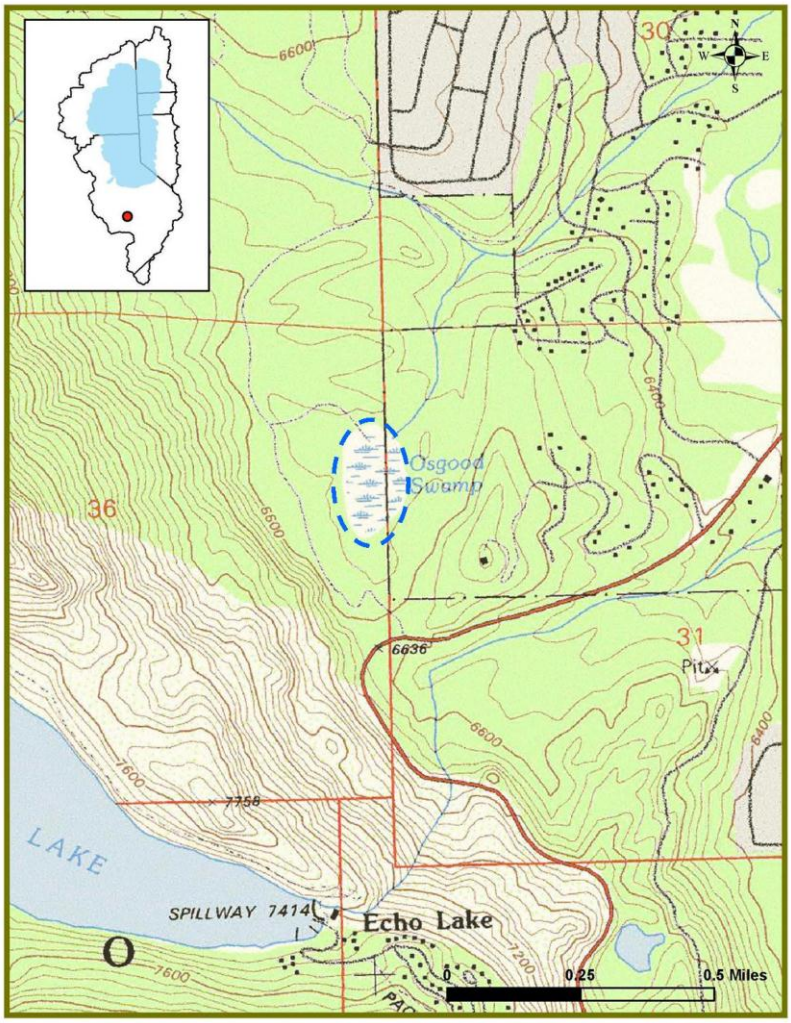


OSGOOD SWAMP
Status: **Somewhat Worse than Target**
Trend: **Moderate Decline**
Confidence: **Low**

Photo



Map



Map showing location of Osgood Swamp and surrounding area.

Data Evaluation and Interpretation

Relevance – Osgood Swamp is a lake located near the base of Echo Summit, adjacent to the town of Meyers. Two separate fen sites have been confirmed on the west and south sides of the lake (Sikes et al. 2011). Fens are peat-forming wetlands that rely on groundwater input rather than precipitation. They are important sites of groundwater discharge, and may serve as indicators of shallow aquifers (Cooper 1990). Fens form slowly over thousands of years; thus, they are not easily restored once destroyed (Cooper et al. 1998). Fens have been identified by the U.S. Forest Service (SNEP 1996; USDA 2004) and in the Tahoe Science Plan, (Hymanson and Collopy 2010) as among the most sensitive habitat types in the Sierra Nevada. Fens are hotspots of biodiversity that support rare plants, insects, and small and large mammals. Vegetation in all wetland types, including fens, marshes and meadows plays an important role in recycling nutrients, trapping eroding soil, and filtering pollutants such as nitrates (Cooper and Wolf 2006). In addition, fens figure prominently in nearly all scenarios of carbon dioxide-induced global climate change because they are major sinks for atmospheric carbon (Chimner and Cooper 2006).
Threshold Category – Vegetation
Indicator Reporting Category – Uncommon Plant Communities
Adopted Standards – Provide for non-degradation of the natural qualities of any plant community that is uncommon to the Basin or of exceptional scientific, ecological, or scenic value. The Threshold Standard shall apply, but not be limited to, 1) the deep-

water plants of Lake Tahoe, 2) Grass Lake, 3) Osgood Swamp, 4) Hell Hole, 5) Upper Truckee Marsh, 6) Taylor Creek Marsh, 7) Freel Peak Cushion Plant Community, and 8) Pope Marsh.

Type of Standard – Numerical (without adopted targets)

Indicator (Unit of Measure) – The status and trend determination was based on a qualitative assessment of the natural qualities of a plant community. The natural qualities of a plant community include the current plant species assemblage, the health, age and ecological condition of those plant species, and the condition of the hydrologic regime.

Status – The two fens at Osgood Swamp are not easily accessible from the decommissioned U.S. Forest Service road on the west side of the swamp, or any of the numerous user trails surrounding the swamp. In the summer, light recreational use from local hikers and cyclists is confined to the well-established trail network. In the winter, cross-country skiing and illegal snowmobile traffic have been observed, but this is also confined to roads surrounding the swamp (TRPA 2007c). The 2006 Threshold Evaluation first noted high levels of beaver activity increasing water levels across the entire area, and causing a possible decline in conditions of the community (TRPA 2007c). A quantitative system for ranking the ecological integrity and quality of fens in the Sierra Nevada has recently become available (Sikes et al. 2011), and was used to assess the attainment status of fens at Osgood Swamp. In the 2010 Lake Tahoe Basin Fen Assessment, the western fen at Osgood Swamp received a Conservation Significance score of 27 out of 40, while the southern fen was one point lower (26), due to its closer proximity to Highway 50. Elements that contributed positively to the rankings include the presence of rare plants and vegetation associations, and the uniqueness of the fens in terms of pH, elevation, and geology. Elements that detracted from the score include the presence of rodent burrows at the southern site and prevalent beaver activity around Osgood Swamp that could be affecting the hydrology, and causing higher water levels than in the past. Conservation significance scores of 26 and 27 are considered high when compared to the range of scores for fens in the Tahoe Basin (18-30 points) and indicate that the natural qualities of the fens exist. However, this evaluation tool does not consider the impacts of beavers on hydrology across the entire swamp. While the two small fens may currently be in acceptable condition, beaver activity is likely altering the hydrology across Osgood Swamp, and therefore, the threshold status was determined to be "somewhat worse than target."

Trend – Since this is the first time that the status of the fens at Osgood Swamp has been assessed based on the Conservation Significance ranking, a trend analysis of that ranking is not possible. The 2006 Threshold Evaluation determined that the condition of Osgood Swamp was declining due to altered hydrology from beaver activity (TRPA 2007c). There has been little change in recreation use at Osgood Swamp in the last five years. The U.S. Forest Service - LTBMU implemented fuel reduction treatments (hand thinning) on about 80 acres of adjacent forest in 2009, and plans to conduct mechanical treatments on an additional 75 acres in the near future. Vegetation monitoring plots have been established in the fens, but these data are not yet available (Engelhardt and Gross 2011a). In the absence of any management actions to address beaver impacts, it must be assumed that the status of Osgood Swamp continues to decline. Therefore, the trend in the condition of Osgood Swamp was assessed as "moderate decline."

Confidence – Confidence in the status, as assessed by the Conservation Significance ranking, was moderate, lower than it is for Grass Lake or Hell Hole because field visits at Osgood Swamp were last conducted during the Region 5 fen inventory in 2006, and not in conjunction with the 2010 Fen Assessment (Sikes et al. 2011). The scoring was in relation to the status of other fens; therefore, there is a degree of uncertainty in the status score. The confidence in the trend analysis was low because of insufficient data. Therefore, confidence in the status and trend at Osgood Swamp was determined to be "low."

Interim Target – It is not possible to set an interim target condition until the quantitative vegetation monitoring data is analyzed. The outcome of that analysis will be a designation of an ecological condition of low, moderate, or high. The target will be to improve the ecological condition of Osgood Swamp unless the rating is high, in which case the target will be to maintain the condition of the area.

Target Attainment Date – It will be possible to set a target attainment date after the quantitative vegetation monitoring data is analyzed.

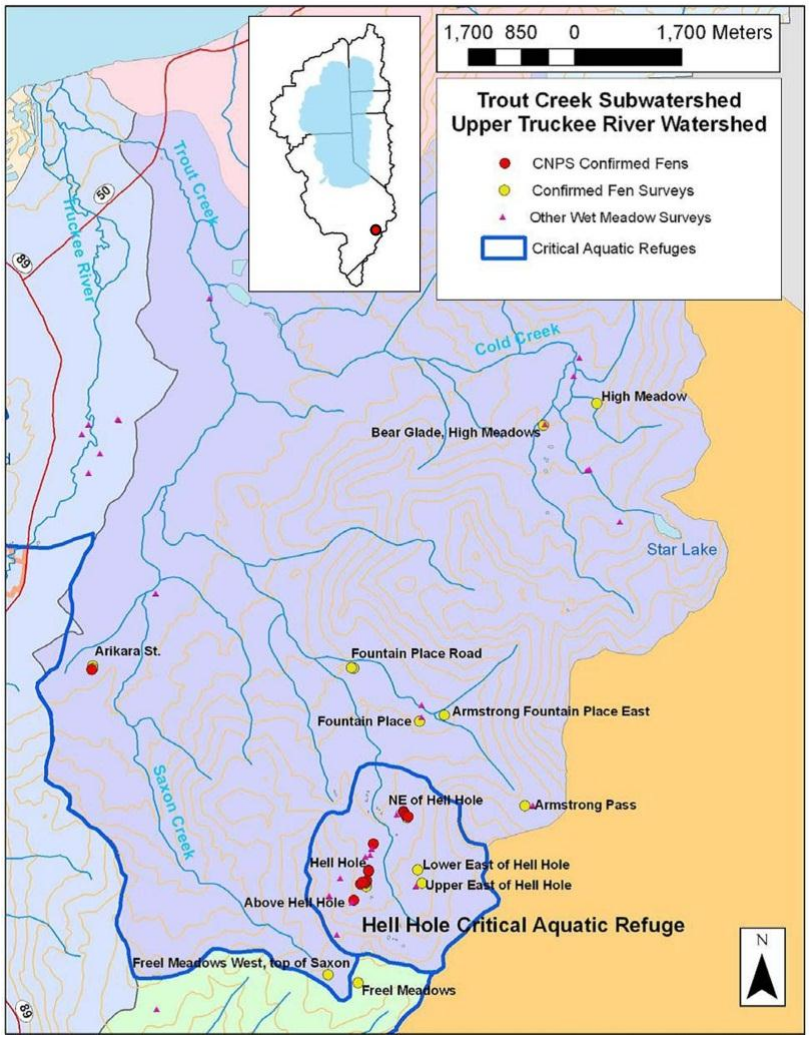
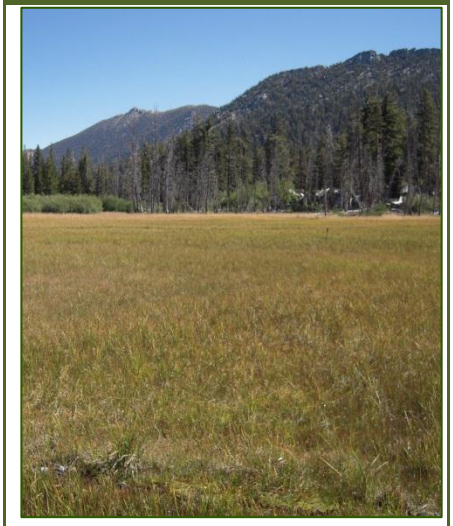
Human & Environmental Drivers – Any condition or activity that disturbs the hydrologic regime or nutrient levels of a fen, or causes drying or changes in plant composition, is a threat to the function of that fen (Cooper 1990). Activities that threaten fens in the Sierra Nevada include timber harvest, mechanical fuel reduction treatments, road and trail construction, stock trampling, off-road vehicles, ground and surface water pumping, and water pollution (Cooper and Wolf 2006). At Osgood Swamp, illegal snowmobile use is concentrated on existing roads outside of the wetland, and a minimum 100-foot buffer around the water is enforced for adjacent mechanical fuel treatments. Currently, hydrologic modification from beaver activity is predicted to be the largest threat to this community. Extended drought and climate change could also negatively impact site hydrology and vegetation (Chimner and Cooper 2002).

Monitoring Approach – Two different monitoring approaches have recently been implemented at Osgood Swamp. As part of the Region 5 Fen Assessment program, a total of 135 potential fens, including Osgood Swamp, have been assessed within the Lake Tahoe Basin since 2006 (Sikes et al. 2011). Of these, a total of 47 locations have been confirmed as fens. In 2010, the U.S. Forest Service collaborated with the California Native Plant Society to develop a quantitative system for ranking the ecological integrity and quality of fens (Sikes et al. 2011). Using this ranking system, surveyors objectively score a fen on eight different

criteria on a five-point scale. The criteria include factors such as rarity, biodiversity, impacts, accessibility, and uniqueness. The Conservation Significance rank is the sum of scores for each criterion and has a maximum value of 40 points. In 2010, the Conservation Significance of the 47 confirmed fens in the Tahoe Basin ranged from a low of 18 to a high of 30.

The second monitoring approach is part of the Region 5 Range Monitoring Program designed to quantify changes in the ecological condition of wetland plant communities (Weixelman et al. 2003). This protocol is designed to enable the user to classify meadows and wetlands according to dominant plant species, elevation, and site moisture characteristics and use a quantitative ecological condition scorecard for that meadow type. The user assigns an ecological condition of low, moderate, or high, based on plant species composition, the presence of different plant functional groups, and other hydrogeomorphic variables. The protocol provides information on the environmental conditions necessary to support certain rare species, and the monitoring design quantitatively tracks rare species abundance. In 2004, two plots and permanent photo points were established at Osgood Swamp (Engelhardt and Gross 2011a). Plots were re-visited in 2009/2010 but the data has not yet been analyzed. Due to the absence of any other available data, these quantitative data will likely form the basis of future Threshold Evaluations.
Monitoring Partners – U.S. Forest Service Lake Tahoe Basin Management Unit, California Native Plant Society
Programs and Actions Implemented to Improve Conditions – TRPA currently implements regulations related to the protection of stream environment zones and uncommon plant communities. Anthropogenic activities known to impact these areas are prohibited.
Effectiveness of Programs and Actions – Current regulations and protection measures provided to this area appear effective at avoiding anthropogenic impacts; however, they are less than effective at addressing the non-native beaver issue.
Recommendation for Additional Actions – Quantitative data on the impacts of beavers on hydrology and vegetation at Osgood Swamp is needed. Document and adopt procedures for long-term monitoring of this site to quantitatively and objectively assess conditions over time.

Uncommon Plant Communities: **Hell Hole**

Reporting Icon	Map
HELL HOLE Status: **At or Somewhat Better than Target** Trend: **Little or No Change** Confidence: **Moderate**	 Map of the location of fen assessment plots established at Hell Hole in 2010 (Sikes et. al 2010).
Photo	
	

Data Evaluation and Interpretation

Relevance – Hell Hole is one of five distinct fens located within the Hell Hole Critical Aquatic Refuge (CAR; a USFS designation), which lies at the western base of Freel Peak (see above Map). At 15 acres, Hell Hole is the largest fen in the CAR and is home to the only known Tahoe Basin population of mountain yellow-legged frogs (*Rana mucosa*), a candidate for listing under state and federal Endangered Species Acts (Sikes et al. 2011). Fens are peat-forming wetlands that rely on groundwater input rather than precipitation. They are important sites of groundwater discharge, and may serve as indicators of shallow aquifers (Cooper 1990). Fens form slowly over thousands of years; thus, they are not easily restored once destroyed (Cooper et al. 1998). Fens have been identified by the U.S. Forest Service (SNEP 1996; USDA 2004) and in the Tahoe Science Plan (Hymanson and Collopy 2010) as among the most sensitive habitat types in the Sierra Nevada. Fens are hotspots of biodiversity that support rare plants, insects, and small and large mammals. Vegetation in all wetland types including fens, marshes and meadows plays an important role in recycling nutrients, trapping eroding soil, and filtering pollutants such as nitrates (Cooper and Wolf 2006). In addition, fens figure prominently in nearly all scenarios of carbon dioxide-induced global climate change because they are major sinks for atmospheric carbon (Chimner and Cooper 2002).
Threshold Category – Vegetation
Indicator Reporting Category – Uncommon Plant Communities
Adopted Standards – Provide for the non-degradation of the natural qualities of any plant community that is uncommon in the Basin,

or of exceptional scientific, ecological, or scenic value. The Threshold Standard shall apply, but not be limited to, 1) the deep-water plants of Lake Tahoe, 2) Grass Lake, 3) Osgood Swamp, 4) Hell Hole, 5) Upper Truckee Marsh, 6) Taylor Creek Marsh, 7) Freel Peak Cushion Plant Community, and 8) Pope Marsh.

Type of Standard – Numerical (without adopted targets)

Indicator (Unit of Measure) – The status and trend determination was based on a qualitative assessment of the natural qualities of a plant community. The natural qualities of a plant community include the current plant species assemblage, the health, age and ecological condition of those plant species, and the condition of the hydrologic regime.

Status – Hell Hole is not accessible by road, and the wet conditions and unstable sphagnum substrate deter hikers and cyclists. LTBMU management actions have focused on the installation of vegetation monitoring plots but the data is not yet available (Shana Gross, personal communication). Grazing was eliminated in the area in 2001 (TRPA 2007c). Recent Threshold Evaluations have assessed the status of Hell Hole as in attainment based on the low level of recreation, and minimal potentially degrading threats (TRPA 2001; TRPA 2007c). A quantitative system for ranking the ecological integrity and quality of fens in the Sierra Nevada has recently become available (Sikes et al. 2011), and was used to assess the attainment status of the Hell Hole fen. In the 2010 Lake Tahoe Basin Fen Assessment, Hell Hole received a Conservation Significance score of 24 out of 40. Elements that contributed positively to the ranking include the presence of rare plants, animals, and vegetation associations, high physical diversity, and a high likelihood of persistence due to its size and proximity to other fens. Elements that reduced the score include its lack of unique features (relative to other fens in the area), relatively homogeneous vegetation, and the presence of the chytrid fungus (*Batrachochytrium dendrobatidis*), which is detrimental to rare amphibians. While chytrid fungus may be present at other fens in the Tahoe Basin, Hell Hole is the only site where presence has been confirmed (Sikes et al. 2011). A Conservation Significance ranking of 24 is midway between the highest (30) and lowest (18) score assigned to fens in the Tahoe Basin. While this is not a particularly high score, the elements that reduced the score (lack of uniqueness, homogeneous vegetation) are not indicative of compromised qualities, and the impact of the fungus on the vegetation quality is unknown. The elements that contributed positively to the ranking, especially the presence of rare species and the high viability, do indicate that the natural qualities of the site are being maintained and that the threshold is "at or better than target."

Trend – Since this is the first time the status of Hell Hole has been assessed based on the Conservation Significance ranking, a trend analysis of that ranking is not possible. Recent Threshold Evaluations have assessed the trend of Hell Hole as improving after the removal of grazing in 2001 (TRPA 2007c), based on evidence that grazing is known to harm fens (Cooper and Wolf 2006). While the chytrid fungus has always been present in aquatic environments, it has only recently become pathogenic (Quinn 2005). The reason for the change is not clear but may be a result of changes in water chemistry and/or temperature. Without data, it is not possible to evaluate whether the presence of the fungus is a sign of declining conditions at Hell Hole, or whether the vegetation has in fact responded positively to the removal of grazing. There have been few changes in recreation use or management actions that have been implemented at Hell Hole in the last five years that would cause a change in the status. Therefore, the trend in the condition of Hell Hole is assessed as "little or no change."

Confidence – The confidence in the status as assessed by the Conservation Significance ranking was high, but the confidence in the trend analysis was low because of insufficient data. Therefore, confidence in the status and trend at Hell Hole is determined to be "moderate."

Interim Target – None, the Threshold Standard is in attainment

Target Attainment Date – None, the Threshold Standard is in attainment

Human & Environmental Drivers – Any condition or activity that disturbs the hydrologic regime or nutrient levels of a fen, or causes drying or changes in plant composition is a threat to the function of that fen (Weixelman and Cooper 2009). Activities that threaten fens in the Sierra Nevada include timber harvest, mechanical fuel reduction treatments, road and trail construction, stock trampling, off-road vehicles, ground and surface water pumping and water pollution (Cooper and Wolf 2006). None of these activities are present in or around Hell Hole. Hydrologic change is predicted to be the largest threat to this community, which could be exacerbated by climate change.

Monitoring Approach – Two different monitoring approaches have been recently implemented at Hell Hole. As part of the Region 5 Fen Assessment program, a total of 135 potential fens, including Hell Hole, have been assessed within the Lake Tahoe Basin Management Unit since 2006 (Sikes et al. 2011). Of these, a total of 47 locations have been confirmed as fens. In addition to this inventory, the Forest Service collaborated with the California Native Plant Society in 2010 to develop a quantitative system for ranking the ecological integrity and quality of fens (Sikes et al. 2011). Using this ranking system, surveyors objectively score a fen on eight different criteria on a five-point scale. The criteria include such factors as rarity, biodiversity, impacts, accessibility, and uniqueness. The Conservation Significance rank is the sum of scores for each criterion and has a maximum value of 40 points. In 2010, the Conservation Significance of the 47 confirmed fens in the Tahoe Basin ranged from a low of 18 to a high of 30.

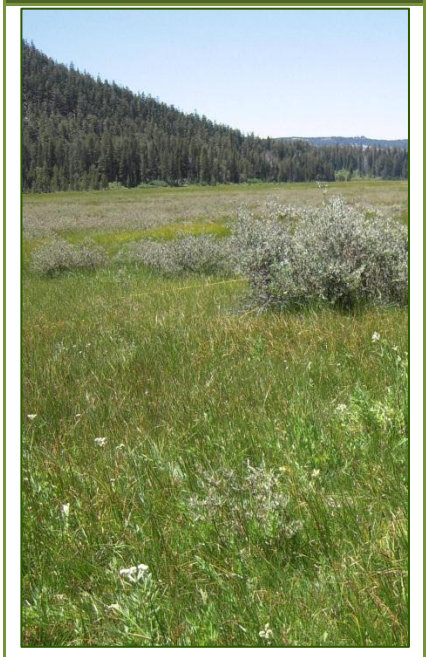
The second monitoring approach is part of the U.S. Forest Service Region 5 Range Monitoring Program designed to quantify changes in the ecological condition of wetland plant communities (Weixelman et al. 2003). The protocol is designed to classify meadows and wetlands according to dominant plant species, elevation, and site moisture characteristics, and then use a customized

quantitative ecological condition scorecard for that meadow type. The user assigns an ecological condition of low, moderate, or high based on plant species composition, the presence of different plant functional groups, and other hydrogeomorphic variables. The protocol also provides information on the environmental conditions necessary to support certain rare species and the monitoring design allows for quantitatively tracking rare species abundance. In 2004, two plots and permanent photo points were established at Hell Hole (Engelhardt and Gross 2011a). Plots were re-visited in 2009/2010 but the data has not yet been analyzed. Due to the absence of any other available data, these quantitative data will likely form the basis of future Threshold Evaluations.
Monitoring Partners – U.S. Forest Service Lake Tahoe Basin Management Unit, California Native Plant Society
Programs and Actions Implemented to Improve Conditions – TRPA currently implements regulations related to the protection of stream environment zones and uncommon plant communities. Anthropogenic activities known to impact these areas are prohibited.
Effectiveness of Programs and Actions – Current regulations and protections appear effective.
Recommendation for Additional Actions – Consider adopting long-term fen monitoring procedures in order to quantitatively and objectively assess conditions of this site over time.

Uncommon Plant Communities: **Grass Lake**

Reporting Icon	Map
GRASS LAKE Status: **At or Somewhat Better than Target** Trend: **Little or No Change** Confidence: **Moderate**	Map showing location of Grass Lake and surrounding area.

Photo



Data Evaluation and Interpretation

Relevance – Grass Lake lies within the Upper Truckee Critical Aquatic Refuge (CAR; a U.S. Forest Service designation) on the southern boundary of the Lake Tahoe Basin. It was established as a U.S. Forest Service Research Natural Area (RNA) in 1991. Grass Lake is roughly 250 acres in size, and has long been considered the largest and best example of a *Sphagnum* fen in the Sierra Nevada (Bittman 1985). *Sphagnum* fens are peat-forming wetlands that rely on groundwater input rather than precipitation. They are important sites of groundwater discharge, and may serve as indicators of shallow aquifers (Cooper 1990). Fens form slowly over thousands of years and thus, they are not easily restored once destroyed (Cooper et al. 1998). Fens have been identified by the U.S. Forest Service (SNEP 1996; Weixelman and Cooper 2010) and in the Tahoe Science Plan (Hymanson and Collopy 2010) as among the most sensitive habitat types in the Sierra Nevada. Fens are hotspots of biodiversity that support rare plants, insects, and small and large mammals. Vegetation in all wetland types, including fens, marshes and meadows, plays an important role in recycling nutrients, trapping eroding soil, and filtering out pollutants such as nitrates (Cooper and Wolf 2006). In addition, fens figure prominently in nearly all scenarios of carbon dioxide -induced global climate change because they are major sinks for atmospheric carbon (Chimner and Cooper 2002).

Threshold Category – Vegetation

Indicator Reporting Category – Uncommon Plant Communities

Standard – Provide for the non-degradation of natural qualities of any plant community that is uncommon to the Basin or of

exceptional scientific, ecological, or scenic value. The Threshold Standards shall apply, but not be limited to, 1) the deep-water plants of Lake Tahoe, 2) Grass Lake, 3) Osgood Swamp, 4) Hell Hole, 5) Upper Truckee Marsh, 6) Taylor Creek Marsh, 7) Freel Peak Cushion Plant Community, and 8) Pope Marsh.

Type of Standard – Numerical (without adopted targets)

Indicator (Unit of Measure) – The status and trend determination is based on a qualitative assessment of the natural qualities of a plant community. Natural qualities of a plant community include the current plant species assemblage, the health, age, and ecological condition of those plant species, and the condition of the hydrologic regime.

Status – Although Grass Lake is located near a major state route, the wet conditions and unstable sphagnum substrate deter hikers and cyclists. Recreational use is mainly limited to cross-country skiing in the winter. The RNA status protects the site from off-road vehicles, grazing, and water diversions. LTBMU management actions have focused on the installation of vegetation monitoring plots within Grass Lake, but the data is not yet available (Engelhardt and Gross 2011a). Fuels reduction treatments in the surrounding area include 100 acres that were mechanically thinned on the west side of Grass Lake in 2008, and about 200 acres are planned for thinning on the opposite side of the highway (USDA 2011b). Extensive roadwork on Highway 89 was completed in 2011, with the central objective to safeguard water quality in Grass Lake and Lake Tahoe.

Recent Threshold Evaluations have assessed the status of Grass Lake as in attainment based on qualitative evaluations of recreation impacts and management actions, rather than any direct measurements of factors that contribute to the integrity of the community (TRPA 2001; TRPA 2007c). A quantitative system for ranking the ecological integrity and quality of fens in the Sierra Nevada has recently become available (Sikes et al. 2011), and was used to assess the attainment status of the fen at Grass Lake. In the 2010 Lake Tahoe Basin Fen Assessment, Grass Lake received the highest Conservation Significance rank of any fen in the Lake Tahoe Basin with a score of 30 out of 40. Elements that contributed to the high ranking include its large size, its status as a Natural Research Area, the presence of rare plants and vegetation associations, high species diversity, low levels of disturbance, and a high likelihood of persistence. This high score combined with the qualitative assessment of management and recreation presented here indicates that the natural qualities of the site are being maintained and that the threshold is "at or better than target."

Trend – Since this is the first time the status of Grass Lake has been assessed based on the Conservation Significance ranking, a trend analysis of that ranking is not possible. No data is available on possible impacts or improvements in the condition of Grass Lake from the surrounding fuel reduction treatments or road improvements. Recent Threshold Evaluations have concluded that the trend was stable (TRPA 2001; TRPA 2007c). However, limited quantitative data is now available that will likely be used in future evaluations. In 2004/2005 the U.S. Forest Service conducted targeted mapping of two sensitive moss species (*Meesia triquetra* and *Sphagnum* spp.) at Grass Lake (Engelhardt and Gross 2011d). Mosses (bryophytes) are good indicator organisms of environmental change due to their relatively simple structures and their sensitivity to various environmental parameters. The targeted moss mapping plots were re-sampled in 2009, and the data indicates that the area occupied by moss declined by approximately 30%, and a 1-25% decline in cover was observed. However, these rapid declines may simply represent natural hydrologic variability; 2005 had greater peak discharge and base flow compared to 2004 and 2009. The sensitive response of fen communities to hydrologic variability means that quantitative changes in trend will require a long-term dataset collected across the full spectrum of hydrologic conditions. Since these data are not yet available, the trend in the condition of Grass Lake is based on the best available information and is assessed as "little or no change."

Confidence – The confidence in the status as assessed by the Conservation Significance ranking was high but the confidence in the trend analysis was low because of insufficient data. Therefore, confidence in the status and trend at Grass Lake is "moderate."

Interim Target – None, the Threshold Standard is in attainment

Target Attainment Date: None, the Threshold Standard is in attainment

Human & Environmental Drivers – Any event or activity that disturbs the hydrologic regime or nutrient levels of a fen or causes drying or changes in plant composition is a threat to the function of that fen (Weixelman and Cooper 2009). Activities that threaten fens in the Sierra Nevada include timber harvest, mechanical fuel reduction treatments, road and trail construction, stock trampling, off-road vehicles, ground and surface water pumping, and water pollution (Cooper and Wolf 2006). The RNA status protects Grass Lake from these activities. Recreational use is light, and the impacts from cross-country skiing in the winter are likely to be negligible. Runoff from State Route 89 has likely been a source of water pollution, but recent road improvements were designed to divert surface road flow away from Grass Lake. Hydrologic change, which could be exacerbated by climate change, is predicted to be the largest threat to this community.

Monitoring Approach – Two different monitoring approaches have recently been implemented at Grass Lake. As part of the Region 5 Fen Assessment program, a total of 135 potential fens, including Grass Lake, have been assessed within the Lake Tahoe Basin Management Unit since 2006 (Sikes et al. 2011). Of these, a total of 47 locations have been confirmed as fens. In addition to this inventory, the U.S. Forest Service collaborated with the California Native Plant Society in 2010 to develop a quantitative system for ranking the ecological integrity and quality of fens (Sikes et al. 2011). Using this ranking system, surveyors objectively score a fen on eight different criteria on a five-point scale. The criteria include such factors as rarity, biodiversity, impacts, accessibility, and uniqueness. The Conservation Significance rank is the sum of scores for each criterion, and has a maximum value of 40 points. In

2010, the Conservation Significance of the 47 confirmed fens in the Tahoe Basin ranged from a low of 18 to a high of 30.

The second monitoring approach is part of the U.S. Forest Service Region 5 Range Monitoring Program designed to quantify changes in the ecological condition of wetland plant communities (Weixelman et al. 2003). The protocol is designed to classify meadows and wetlands according to dominant plant species, elevation, and site moisture characteristics, and then use a customized quantitative ecological condition scorecard for that meadow type. The user assigns an ecological condition of low, moderate, or high based on plant species composition, the presence of different plant functional groups, and other hydrogeomorphic variables. The protocol provides information on the environmental conditions necessary to support certain rare species, and the monitoring design allows for quantitatively tracking rare species abundance. In 2004, ten plots and ten permanent photo points were established at Grass Lake (Engelhardt and Gross 2011a). The moss mapping plots were installed at the same time (Engelhardt and Gross 2011d). All plots were re-visited in 2009/2010, but the data have not yet been analyzed. These quantitative data will likely form the basis of future Threshold Evaluations.

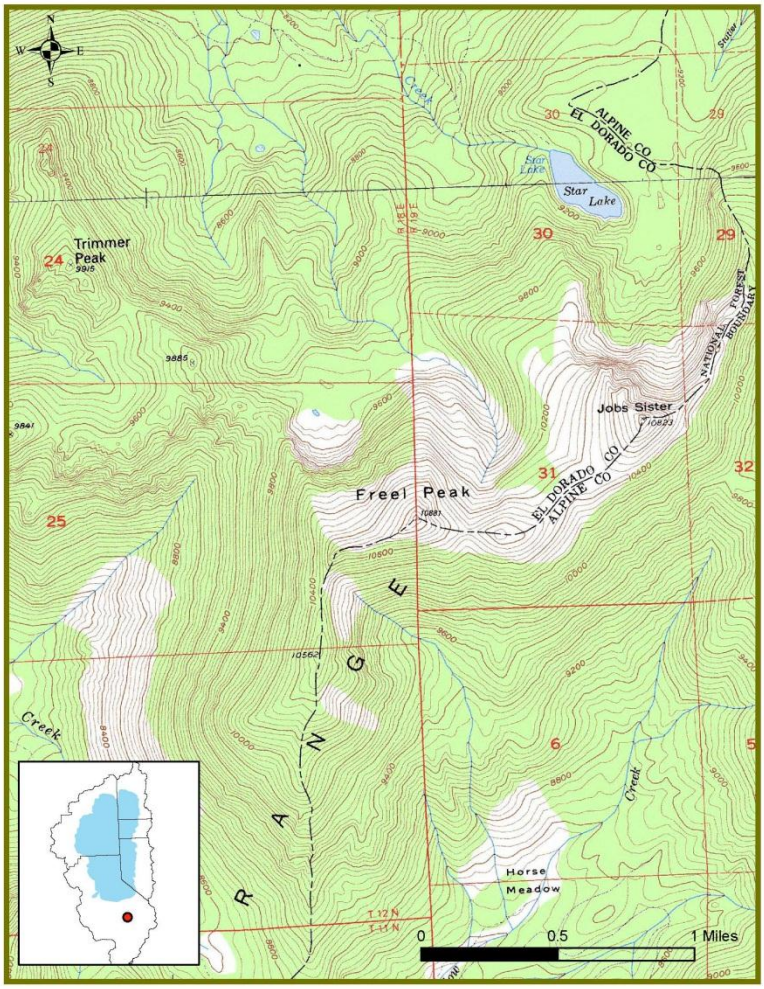
Monitoring Partners – U.S. Forest Service Lake Tahoe Basin Management Unit, California Native Plant Society

Programs and Actions Implemented to Improve Conditions – TRPA currently implements regulations related to the protection of stream environment zones and uncommon plant communities. Anthropogenic activities known to impact these areas are prohibited. U.S. Forest Service designations as a RNA and CAR provide additional protections to Grass Lake.

Effectiveness of Programs and Actions – Runoff from State Route 89 has likely been a source of water pollution, but recent road improvements were designed to divert surface road flow away from Grass Lake. Current regulations and protection measures appear effective.

Recommendation for Additional Actions – Consider adopting long-term fen monitoring procedures in order to quantitatively and objectively assess conditions of this site over time.

Uncommon Plant Communities: **Freel Peak Cushion Plant Community**

Reporting Icon	Map
FREEL PEAK CUSHION PLANT COMMUNITY Status: **At or Better than Target** Trend: **No Change** Confidence: **Low**	 Map showing location of Freel Peak and surrounding area.

Photo

Data Evaluation and Interpretation

Relevance – Cushion plants are low, matted growth forms that look like pincushions. This growth form allows them to withstand extreme climates with gusting winds, snow, and huge temperature variation (Malcolm and Malcolm 1988). The main occurrence of this plant community type in the Basin is at elevations above 9,000 ft. on the cluster of peaks around Freel Peak (Engelhardt and Gross 2011a). The Freel Peak Cushion Plant Community supports a variety of uncommon plant species, including one of the main population centers of the sensitive species, Tahoe draba (*Draba asterophora* var. *asterophora*), specially designated by TRPA and the U.S. Forest Service to provide the plants with increased levels of protection (Englehardt and Gross 2011b). Cushion plants possess many unique adaptations for surviving in harsh climates with little water availability or soil development. They have been referred to as ecosystem engineers because of their ability to locally maintain increased soil moisture and temperature relative to adjacent soils (Badano et al. 2006).

Threshold Category – Vegetation

Indicator Reporting Category – Uncommon Plant Communities

Adopted Standards – Provide for the non-degradation of the natural qualities of any plant community that is uncommon to the Basin or of exceptional scientific, ecological, or scenic value. The threshold shall apply, but not be limited to, 1) the deep-water plants of Lake Tahoe, 2) Grass Lake, 3) Osgood Swamp, 4) Hell Hole, 5) Upper Truckee Marsh, 6) Taylor Creek Marsh,

7) Freel Peak Cushion Plant Community, and 8) Pope Marsh.

Type of Standard – Management

Indicator (Unit of Measure) – The status and trend determination is based on a qualitative assessment of the natural qualities of a plant community. Natural qualities of a plant community include the current plant species assemblage, the health, age, and ecological condition of those plant species, and the condition of the hydrologic regime.

Status – At 10,881 feet, Freel Peak is the highest peak in the Lake Tahoe Basin, and is thus a popular hiking destination. Over time, numerous user-created trails crisscrossing the habitat were likely causing declines in the cushion plant community (Englehardt and Gross 2011b). In 2006, in an effort to concentrate recreational use and decrease trampling, the U.S. Forest Service constructed a dedicated trail to the top of the peak, and installed an interpretive sign about the sensitive plants in the area. Also in 2006, long-term monitoring plots were established on Freel Peak and two adjacent summits, following the Global Observation Research Initiatives in Alpine Environments (GLORIA) protocol (GLORIA 2011). The GLORIA project is a world-wide long-term observation network in alpine environments that was established with the aim of documenting changes in biodiversity and vegetation patterns caused by changing climate in the world's high mountain ecosystems. Quantitative data are available from a monitoring program focused on the Tahoe draba. Plots are surveyed on a five-year rotation, but the data from the 2011 survey are not yet available. Tahoe draba has a classic cushion growth form and its status may therefore serve as an indicator of the status of the entire cushion plant community. Quantitative monitoring of Tahoe draba on Freel Peak began in 2004 when plants were located at 10 population sites (Engelhardt and Gross 2011b). When sites were re-surveyed in 2009, plant counts of Tahoe draba were stable at all 10 population sites, and three new sites were discovered. Stability in the plant counts, and an increase in the number of sites of a representative species, indicate that the natural qualities of the cushion plant community are being maintained, or possibly improving. Therefore, the status of the Freel Peak Cushion Plant Community was determined to be "at or better than target."

Trend – The high elevation cushion plant community is known to be a naturally stable type (Malcolm and Malcolm 1988), and plant counts of the Tahoe draba over the last five years were stable at the 10 population sites that have been surveyed twice (Englehardt and Gross 2011b). Although the recent discovery of three new Tahoe draba sites within the cushion plant community may point to an increasing trend, it may simply be a result of increased survey effort. With only two surveys it is not possible to assess a reliable trend in the abundance of cushion plants. Therefore, a conservative approach leads to the conclusion that there was "little or no change" in the trend of the Freel Peak Cushion Plant Community.

Confidence – The confidence in the status and trend determination is "low" because the analysis is based on data for only one representative species that occurs within the community and from only two sample periods in 2004 and 2009.

Interim Target – None, the Threshold Standard is currently in attainment.

Target Attainment Date – None, the Threshold Standard is currently in attainment.

Human & Environmental Drivers – Environmental conditions are extreme and the growing season for the Freel Peak Cushion Plant Community is only four months long. Although climate change is considered to be the greatest threat to such alpine communities, recreational use also has the potential to degrade the community. Trampling of Tahoe draba in the area has been observed (Engelhardt and Gross 2011b). Decreased snowpack and/or earlier snowmelt have the potential to impact the cushion plant community by altering species composition and interactions, and decoupling plant flowering periods and insect pollinator visitation.

Monitoring Approach – In 2009, the U.S. Forest Service – LTBMU installed four permanent plots targeting the Tahoe draba population in the Freel Peak Cushion Plant Community. The plots will be visited every five years to provide a quantitative and consistent method for evaluating the status and trend of this sensitive species. Data on the status and trend of Tahoe draba was used as an indicator of the status and trend of the cushion plant community as a whole. Another long-term monitoring approach was recently initiated within the Freel Peak Cushion Plant Community, which will provide information to increase the rigor and confidence of future threshold evaluations. The U.S. Forest Service Pacific Southwest Research Station (PSW) has taken the lead in organizing monitoring efforts associated with the GLORIA project throughout the state of California. GLORIA plots are surveyed on a five-year rotation and the first re-survey of the Freel Peak plots took place in 2011. The project uses sophisticated monitoring and data collection methods focused on plants and continuous soil temperature measurements that have been thoroughly tested and extensively applied across the network of sites in Europe. Data, when available, will become a central part of the evaluation of the status and trend of the Freel Peak Cushion Plant Community.

Monitoring Partners – U.S. Forest Service, Lake Tahoe Basin Management Unit, Pacific Southwest Research Station (PSW) and the GLORIA network

Programs and Actions Implemented to Improve Conditions – The completion of a dedicated trail to the top of Freel Peak in 2006 was intended to concentrate recreational use and decrease trampling of the cushion plant community. Additionally, TRPA currently implements regulations related to the protection of uncommon plant communities.

Effectiveness of Programs and Actions – The fact that Tahoe draba has been discovered at three new sites and that plant counts have been stable since the installation of the trail improvements indicates that the trail may have reduced trampling of the entire cushion plant community.

Recommendation for Additional Actions – Consider adopting assessment procedures for long-term monitoring of this site to quantitatively and objectively assess conditions over time.

Sensitive Plants

The Lake Tahoe Basin supports a diverse array of plants. Over 1,000 vascular plants and at least 115 species of non-vascular plants have been confirmed to occur, with another 360 species potentially occurring (USDA 2000). Currently, the special status plant list includes 30 vascular plants, 12 non-vascular plants, and one fungus. The special status plant list includes U.S. Forest Service, Region 5 Sensitive Plants, LTBMU Target Species, and TRPA listed sensitive plant species. Of these 43 special status species, botany and ecology staff monitors 21 species known to occur in the Basin. Eight species are known only from text or herbarium records, and 14 special status species potentially occur based on habitat preference or other environmental criteria, but have not been documented in the Basin. Tahoe yellow cress (*Rorippa subumbellata*) is the only plant listed as Endangered by the states of California and Nevada. It is also a candidate for listing under the Federal Endangered Species Act.

TRPA policy emphasizes conservation of special status plant species. The Threshold Standard applies to five species; "maintain a minimum number of populations sites" for *Arabis rigidissima* var*. demota* – Galena Creek rockcress, (7), *Draba asterophora* var*. asterophora* – Tahoe draba (5), *D. asterophora* var*. macrocarpa* – Cup Lake draba (2), *Lewisia longipetala* – Long-petaled lewisia (2), and *Rorippa subumbellata* – Tahoe yellow cress (26). "Population site" has been interpreted as any location where plants have been mapped. However, this approach does not reflect a biological understanding of a plant population. The biological definition of a plant population describes a unit where plants within interact and are more closely related with each other than with plants from a different population (NatureServe 2004). Distance often determines the degree of interaction between plants, and the standardized Natural Heritage Program methodology uses a minimum default separation distance of 1 km for defining and tracking plant populations. Subpopulations can be tracked to gain information in more localized areas, and the "population sites" discussed in the present evaluation would be considered subpopulations within the NatureServe methodology.

In the present evaluation, Threshold Standard attainment is based on the number of populations mapped in various monitoring efforts. Using this approach, four of the five species were determined to be in attainment and considered "at or better than target" (Figure 6-4). Insufficient information was available for the Galena Creek rockcress to make a determination on attainment status or trend. Although the characterization of the Sensitive Plant Indicator Reporting Category is "considerably better than target," it is recommended that the Threshold Standard be updated to better reflect a biological understanding of a plant species population. Recommendations for each of the five species are presented, and in all cases the recommended changes target biologically important populations for conservation and increased protection for the species.

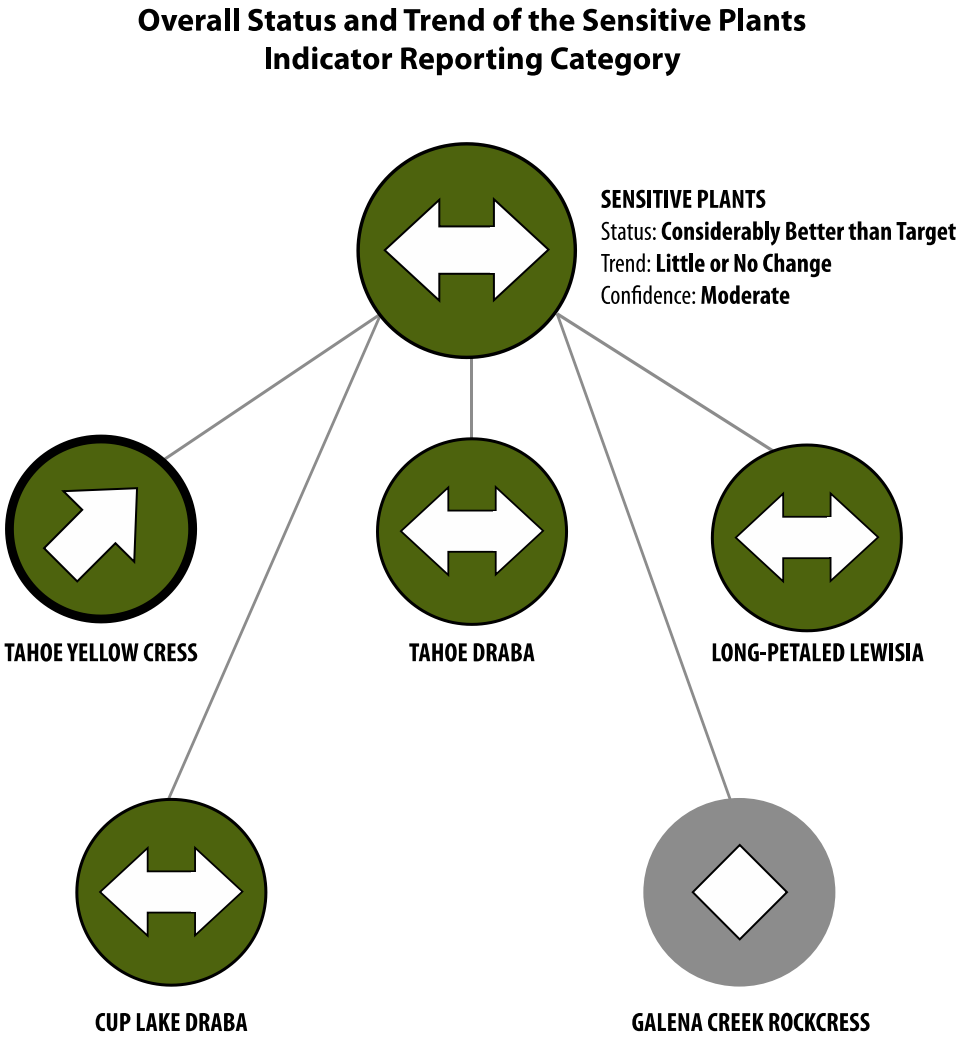
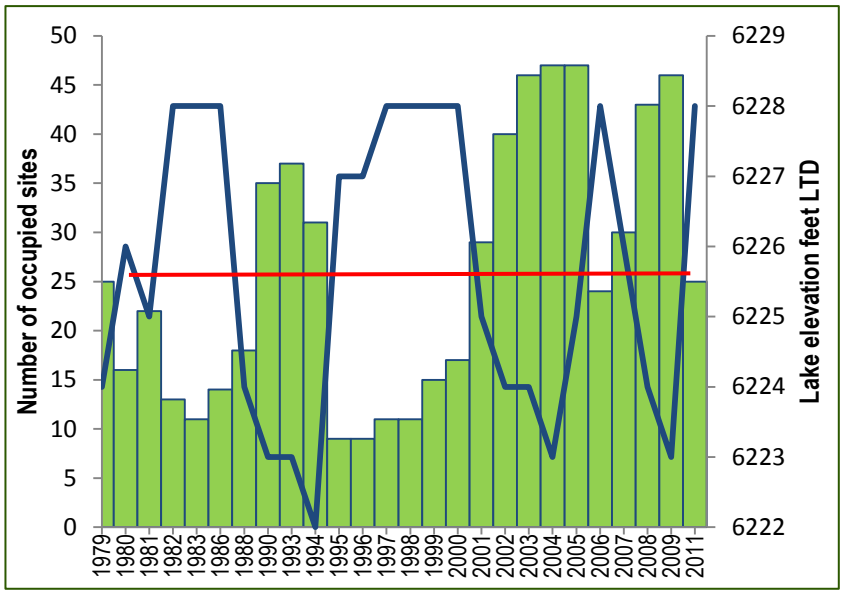
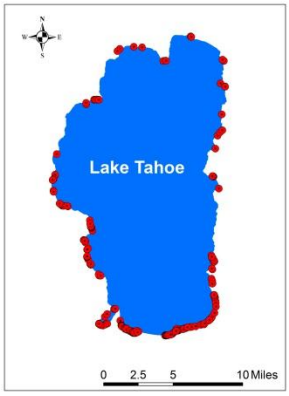


Figure 6-4. *Reporting icons for the five indicators evaluated in the Sensitive Plants Indicator Reporting Category. Results from each of the five indicators (bottom) were evaluated and aggregated to characterize the overall status of the Sensitive Plants Indicator Reporting Category (top).*

Sensitive Plants: **Tahoe Yellow Cress (*Rorippa subumbellata*)**

Reporting Icon	Trend
TAHOE YELLOW CRESS Status: **Considerably Better than Target** Trend: **Moderate Improvement** Confidence: **High**	 Number of sites occupied by Tahoe yellow cress and the level of Lake Tahoe during the survey period from 1979 to 2011. Lake level (solid blue line) is in feet of elevation Lake Tahoe Datum (LTD). The red line indicates the Threshold Standard of 26 occupied sites. Source: Tahoe Yellow Cress Working Group.
Map	
 Approximate locations of Tahoe yellow cress in the Lake Tahoe Basin, September, 2011.	

Data Evaluation and Interpretation

Relevance – Tahoe yellow cress (*Rorippa subumbellata)* is a small perennial plant in the Brassicaceae (Mustard) family. The species has small yellow flowers and is characterized by fleshy leaves and a spreading growth form (Ferreira 1987). Tahoe yellow cress occurs on the sandy shores of Lake Tahoe and nowhere else in the world (CNPS 2010). The species is listed as Endangered in California, Critically Endangered in Nevada, and has been a candidate species for listing under the federal Endangered Species Act since 1999. This high level of protection is the greatest of any plant occurring in the Basin. In response to near extinction of the species in the late 1990s, a Conservation Strategy for Tahoe Yellow Cress was completed in 2002. Thirteen stakeholders, including TRPA, signed a Memorandum of Understanding agreeing to implement the strategy (Pavlik et al. 2002).

Threshold Category – Vegetation

Indicator Reporting Category – Sensitive Plant Species

Adopted Standards – Maintain 26 Tahoe yellow cress population sites.

Type of Standard – Numerical Standard

Indicator (Unit of Measure) – The total number of population sites that are maintained as suitable habitat as determined by a qualified expert.

Status – The current Threshold Standard of 26 population sites was established in 1982 when the survey record for Tahoe yellow cress had only three years of data (TRPA 2007c). Since then, standardized surveys for Tahoe yellow cress have been

conducted in the first week of September at up to 62 population sites around Lake Tahoe (Stanton and Pavlik 2010). These monitoring sites are distributed around the entire Lake shoreline, and each site is known to have supported Tahoe yellow cress at some point since the species was first described in 1941. In 2002, the Conservation Strategy illustrated that the distribution and abundance of Tahoe yellow cress in any given year is closely linked to the water elevation of Lake Tahoe; the greatest number of sites is occupied when Lake elevation is low (Pavlik et al. 2002). Lake Tahoe is regulated between the natural rim at 6,223 feet (Lake Tahoe Datum, LTD) and the maximum legal limit set at 6,229.1 feet LTD. Tahoe yellow cress habitat occurs solely on sandy beaches within this zone. With respect to Tahoe yellow cress, the Lake is considered low (6,223-6224 ft.), in transition (6,225-6226 ft.), or high (>6226 ft.) as measured in the first week of September when the surveys are conducted. The current dataset from 1979 to 2011 includes 26 years where >50% of the known population sites were monitored, and is balanced with a nearly equal number of years of low (10) and high (11) Lake level years, with five transition years. During this period the average number of occupied sites at low Lake levels was 36.8, in transition years it was 28.8, and at high Lake levels only 14.5 sites were occupied. This long-term dataset reveals that the current Threshold Standard is not likely to be met under high Lake levels, but that it is attainable at most other Lake levels. Over four of the last five years (no survey was conducted in 2010) the number of sites occupied by Tahoe yellow cress ranged from a low of 25 in 2011 to a high of 46 sites in 2009 (see above figure). During this three-year period, the average number of population sites occupied by Tahoe yellow cress was 34, which is considerably more than the target of 26. The Threshold Standard is in attainment, calculated at 131% of the Threshold Standard over the last five years. The indicator was determined to be "considerably better than target."

Trend – The trend for the species in any given period varies with Lake level. Over the last five years Lake level has fluctuated from high to low and back to high again, while the number of population sites occupied by Tahoe yellow cress fluctuated from 24 to 46 and back down to 25 (see above figure). In the previous five-year period, the number of occupied sites fluctuated between 29 and 47, so the short-term trend of Tahoe yellow cress has not changed. In contrast, the trend for Tahoe yellow cress since the adoption of the Conservation Strategy in 2002 has shown rapid improvement. During the period from 1979 to 2001, an average of 39 sites was surveyed each year and 19 of those sites were occupied. From 2002 to 2011, the average number of surveyed sites climbed to 59, and 39 of those were occupied. Some of this increase may be due to an increase in survey effort and because there were fewer high Lake level years from 2002-2011 than in the previous survey period. Since there was no change in the short-term, but a rapid improvement in the longer term, the overall trend for Tahoe yellow cress was determined to be "moderate improvement."

Confidence – There is a high degree of confidence in the status and trend based on the longevity of the monitoring program and the quality of the data collected.

Interim Target – None, the Threshold Standard is currently in attainment.

Target Attainment Date – None, the Threshold Standard is currently in attainment.

Human & Environmental Drivers – High levels of recreational activities that can cause trampling of plants on both public and private beaches pose a significant threat to Tahoe yellow cress (Stanton and Pavlik 2011). Beach raking to remove debris and vegetation, and construction of piers, jetties, and other structures can directly destroy plants and decrease the amount of suitable habitat (Pavlik et al. 2002). These human-caused impacts are intensified when the level of Lake Tahoe is high (>6,226 ft. LTD), and less sandy beach habitat is available due to the geometry of the filling basin (Pavlik et al. 2002). Successive years of high Lake level have the potential to seriously reduce the presence and abundance of Tahoe yellow cress; between 1995 and 2000, the number of occupied Tahoe yellow cress sites declined from 37 in 1993, to only 9 in 1995-96, prompting concerns of imminent extinction of the species (Pavlik et al. 2002). Climate change may also adversely affect Tahoe yellow cress populations through altered levels of runoff into the Lake.

Monitoring Approach – Quantitative monitoring of Tahoe yellow cress began in 1979 (Knapp 1979). Survey effort has varied over the years, but the number of regularly surveyed locations has expanded during that time from 38 to 62 population sites (Stanton and Pavlik 2010). At occupied sites, the abundance of Tahoe yellow cress is recorded as stem counts, and notes are taken regarding land use and potential or actual impacts to the species. In 2010, the Tahoe yellow cress Adaptive Management Working Group (AMWG) shifted from an annual survey to an adaptive survey strategy where the Lake-wide monitoring effort is now linked to Lake level (Stanton and Pavlik 2011). Surveys are conducted every year that the Lake is at or above 6,226 ft. LTD, and every other year when the Lake is lower.

Monitoring Partners – Monitoring is implemented by the AMWG. Members include resource staff from the following entities: TRPA, U.S. Forest Service, US Fish and Wildlife Service, US Bureau of Reclamation, California State Parks, California Tahoe Conservancy, California Department of Fish and Game, California State Lands Commission, Nevada Division of State Lands, Nevada Division of Forestry, Nevada Natural Heritage Program, Natural Resources Conservation Service, Tahoe Resource Conservation District, Nevada Tahoe Conservation District, and Tahoe Lakefront Owner's Association.

Programs and Actions Implemented to Improve Conditions – The Conservation Strategy for Tahoe yellow cress was completed in 2002, and 13 entities signed a Memorandum of Understanding agreeing to implement the strategy (Pavlik et al. 2002). The overall intent of the Strategy is to eliminate the need to list Tahoe yellow cress under the federal Endangered

Species Act (ESA). It specifies an adaptive management framework and a focused research agenda to assist land and resource managers in meeting the habitat needs of the species. A field-based research program of experimental plantings of container-grown Tahoe yellow cress plants, conducted at various beaches around the Lake from 2003 to 2009, investigated the role of genetic, hydrologic, and logistical factors in population restoration. The field research program has also tested the effectiveness of translocation (moving naturally occurring plants from one place to another). The Conservation Strategy specifies that a Stewardship program is an integral piece of successful conservation because in any year, up to 50% of known Tahoe yellow cress plants are located on private land. A Stewardship committee was formed in 2007 with the goal of creating and distributing educational materials, and to facilitate research and active conservation on private lands. In October 2010, the Natural Resources Conservation Service and the Nevada Tahoe Conservation District (NTCD) entered into a cooperative agreement to develop Conservation Plans to help private property owners protect Tahoe yellow cress on their private lands. On public beaches, fences have been installed and maintained to protect key population sites.

Effectiveness of Programs and Actions – The average number of sites around Lake Tahoe occupied by Tahoe yellow cress has increased by 20 since the adoption of the Conservation Strategy in 2002. Although that increase is somewhat skewed by fewer high Lake-level years and an increase in survey effort since 2002 compared to the previous survey period (1979 to 2001), this increased survey effort is a direct result of Conservation Strategy implementation. The field-based research program has successfully identified the optimal planting techniques, and many of the plant characteristics, habitat conditions, and logistical factors that influence restoration/mitigation success, thereby, increasing management options for the species. Such tangible benefit to the species prompted the U.S. Fish and Wildlife Service to downgrade Tahoe yellow cress in 2005 from a priority 2 to a priority 8 Candidate because of "continued commitments to conservation demonstrated by regulatory and land management agencies participating in the Conservation Strategy" (USFWS 2004). In 2009, the Stewardship Program produced a tri-fold brochure about the unique aspects of Tahoe yellow cress and developed a website (www.tahoeyellowcress.org). As of 2011, the NTCD has developed 13 Conservation Plans for private landowners with suitable Tahoe yellow cress habitat.

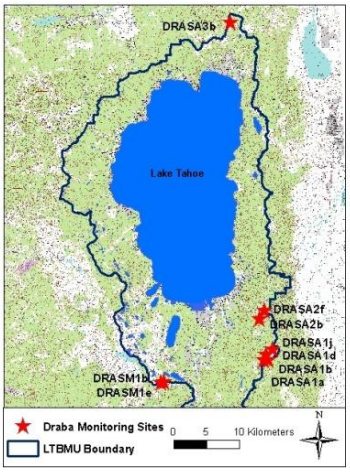
Recommendation for Additional Actions – The Conservation Strategy is set to expire at the end of 2012, ten years after its adoption. The increase in the number of occupied sites since 2002 indicates that the Conservation Strategy is working and that it should be updated and renewed. In addition, a greater number of stakeholders that did not sign the original MOU have become involved, including the US Bureau of Reclamation, the Natural Resources Conservation Service, the Tahoe Resource Conservation District, and the Nevada Tahoe Conservation District. These entities have indicated a desire to become official participants in the MOU, and it is recommended that the update and renewal process allow for the addition of new participants.

Sensitive Plants: **Tahoe Draba (*Draba asterophora* var. *asterophora)***

Reporting Icon

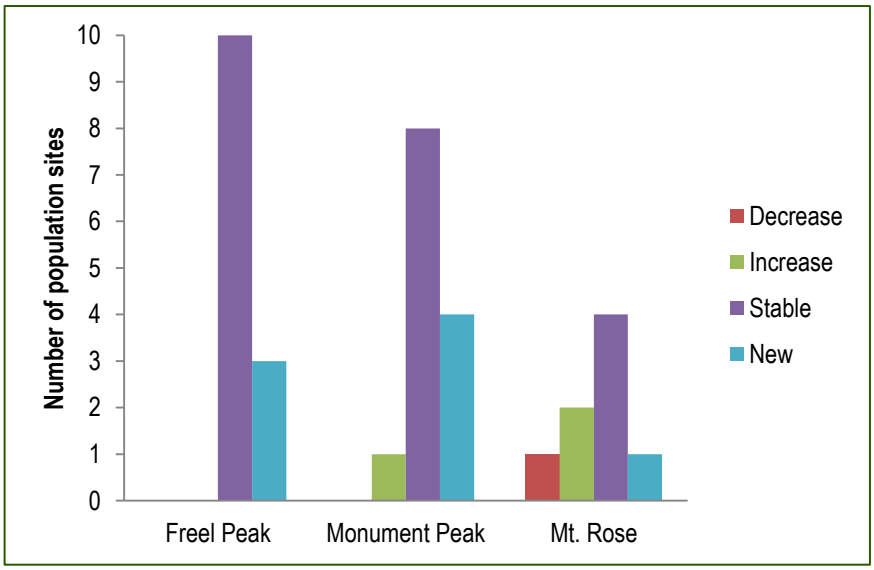
TAHOE DRABA
Status: **Considerably Better than Target**
Trend: **Little or No Change**
Confidence: **Moderate**

Map



Approximate locations of Tahoe draba (labeled DRASA) in the Lake Tahoe Basin, September, 2010.

Trend



Number of population sites of Tahoe draba where plant counts decreased, increased, were stable, or where new population sites were detected between 2004 and 2009. Source: U.S. Forest Service - LTBMU.

Data Evaluation and Interpretation

Relevance – Tahoe draba (*Draba asterophora* var. *asterophora)* is a small alpine perennial plant in the Brassicaceae (Mustard) family. The species has small yellow flowers and is characterized by a pincushion growth form where all the foliage grows close to the ground in a short mound or mat (Baad 1979). The worldwide distribution of Tahoe draba is limited to high elevation (>8,000 feet) peaks in the vicinity of Lake Tahoe. Within the Tahoe Basin, the species is found at Mount Rose in the north, and the Freel Peak/Jobs Sister and Monument Peak areas in the south. Although there are a few occurrences located adjacent to the Lake Tahoe Basin in the Humboldt-Toiyabe National Forest, the largest number of plants occur in the Tahoe Basin populations; thus the status of Tahoe populations is critical to the viability of the entire species. Tahoe draba has special designations by TRPA and the U.S. Forest Service, who provide the plants with increased levels of protection.
Threshold Category – Vegetation
Indicator Reporting Category – Sensitive Plants
Adopted Standards – Maintain five Tahoe draba population sites.
Type of Standard – Numerical Standard
Indicator (Unit of Measure) – The total number of population sites that are maintained as suitable habitat as determined by a qualified expert.
Status – The Tahoe draba currently exists in the Lake Tahoe Basin in three general locations near Freel Peak, Monument Peak, and Mt. Rose. Plants are mapped and tracked at these locations in a combined total of 34 population sites, which is considerably more than the target of five population sites. Therefore, the Threshold Standard is in attainment and was

determined to be "considerably better than target."

Trend – Quantitative monitoring of Tahoe draba began in 2004 when plants were located and counted at 22 population sites (Englehardt and Gross 2011b). An additional three sites were added in a limited survey in 2005. All sites were re-surveyed in 2009. Between 2004/05 and 2009, plant counts at 22 of the 25 population sites (88%) were stable, increased at two (8%) and one site originally identified was not found (4%). In 2009, nine new population sites were added, bringing the total number of sites to 34 (above figure). The addition of new sites may point to an increase in the abundance of Tahoe draba, or simply an increase in survey effort, but with only two data sets it is not statistically possible to assess a trend. Given the fact that plant counts at 88% of the population sites were stable over the last five years and that the high elevation cushion plant community where Tahoe draba occurs is known to be a naturally stable type, a conservative approach leads to the conclusion that there was no change in the trend of Tahoe draba.

Confidence – There is a high degree of confidence in the status based on the quality of the data collected and the robust nature of the monitoring program. However, there is low confidence in the trend determination because the trend analysis is based on data from only two sample periods in 2004/05 and 2009. Therefore, there is a "moderate" level of confidence in the status and trend.

Interim Target – None, the Threshold Standard is currently in attainment.

Target Attainment Date – None, the Threshold Standard is currently in attainment.

Human & Environmental Drivers – Human activities that pose direct threats include recreational activities that might trample or uproot plants (e.g., camping, hiking, equestrian use, trail construction, snowmobiles) and the construction and maintenance of ski resort facilities. Freel Peak is a popular hiking destination because it is the tallest peak in the Basin, and trampling of Tahoe draba in the area has been observed (Engelhardt and Gross 2011b). Snowmobile traffic may increasingly be cause for concern at the Mount Rose and Freel Peak/Jobs Sister areas (Engelhardt and Gross 2011b). Tahoe draba is found at both Heavenly Ski Resort and Mt Rose Ski Tahoe where construction and maintenance of ski facilities have the potential to directly impact entire population sites. Preliminary results from one study indicate that grading of ski runs is correlated with lower plant densities, smaller plant sizes, and higher annual mortality rates (Smith et al. 2008). The strongest environmental driver of Tahoe draba distribution and abundance may come through changes in precipitation type, timing, and quantity associated with climate change. Decreased snowpack and/or earlier snowmelt have the potential to impact populations by altering plant community composition and species interactions, and decoupling plant flowering periods and insect pollinator visitation.

Monitoring Approach – A comprehensive monitoring program for Tahoe draba was initiated in 2009 when long-term plots were installed at nine population sites (Engelhardt and Gross 2011b). These populations are visited every five years, or more frequently when data suggests the population is decreasing. The monitoring objective is to provide a quantitative and consistent method for evaluating status and trend, especially at sites comprised of large numbers of plants where it is difficult to accurately count individuals. Monitoring in permanent plots allows for more repeatable and efficient surveys.

Monitoring Partners – Ecology and botany staff from the U.S. Forest Service – LTBMU, and the Humboldt-Toiyabe National Forest developed the long-term monitoring plan. The U.S. Forest Service is monitoring populations on both forests.

Programs and Actions Implemented to Improve Conditions – A Memorandum of Understanding was signed in 2006 between the U.S. Forest Service (Humboldt-Toiyabe National Forest and U.S. Forest Service – LTBMU), Mt Rose Ski Tahoe, Heavenly Ski Resort, and TRPA (MOU 2006). The MOU contains specific actions such as developing a long-term monitoring program and initiating development of a Conservation Assessment/ Strategy to streamline management of Tahoe draba across its known range; however, the MOU expired in 2011 and has not been renewed.

Effectiveness of Programs and Actions – In 2006, the USFS installed an official trail to the top of Freel Peak to concentrate use and direct foot traffic away from Tahoe draba. The effort appears to have reduced impacts to plants, but a lack of baseline data makes it impossible to quantitatively assess the effectiveness. In contrast, translocations of plants prior to lift construction projects at both Heavenly Ski Resort and Mt Rose Ski Tahoe have been unsuccessful and are not an effective mitigation strategy (Engelhardt and Gross 2011b).

Recommendation for Additional Actions – To continue long-term monitoring and streamlined management of Tahoe draba, it is recommended that the expired MOU between the U.S. Forest Service (Humboldt-Toiyabe National Forest and LTBMU), Mt Rose Ski Tahoe, Heavenly Ski Resort, and TRPA be updated and reinstated. The current Threshold Standard of maintaining five population sites represents only 15% of the 34 different population sites where Tahoe draba is currently being monitored. In addition to being insufficient, the standard also lacks conservation relevance because it does not reflect a biological understanding of a plant population. A biological definition of a plant population describes a unit where plants interact and are more closely related with each other than with plants from a different population (NatureServe 2004). Accordingly, Tahoe draba exists in the Tahoe Basin in three populations centered at Freel Peak, Monument Peak, and Mt**.** Rose. An ongoing dissertation research project at Brigham Young University has found significant differences in the genetic structure of these three main population clusters, providing further support for recognizing each locale as a distinct biological population (Smith et al. 2008). It is therefore recommended that the Threshold Standard be changed from five to three populations, comprised of at least five subpopulations each, and that at least one of these subpopulations is comprised of a minimum of 1,000 plants. A population is

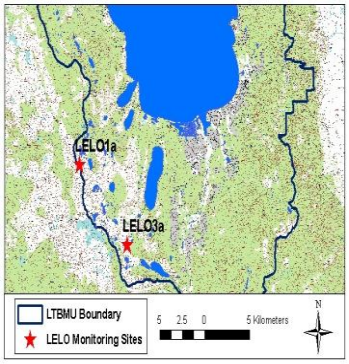
defined as occurring at least 1km from other populations, and a subpopulation is defined as a discrete occurrence of interacting plants within 1km of other subpopulations. This change would better reflect the biologically important populations for conservation, and it increases protection for the species by specifying 15 subpopulations sites for protection rather than the current five. The rationale for protecting five subpopulations is based on the trend in census counts over the last five years where plant counts were stable or increased to ten subpopulations near Freel Peak, nine near Monument Peak, and five near Mt Rose. While five subpopulations is the lowest common denominator, it improves protection of the species by three times the current Threshold Standard. If these proposed changes were adopted, the current and expected near-term status of Tahoe draba would remain "considerably better than target."

Sensitive Plants: **Long-petaled Lewisia (*Lewisia longipetala*)**

Reporting Icon

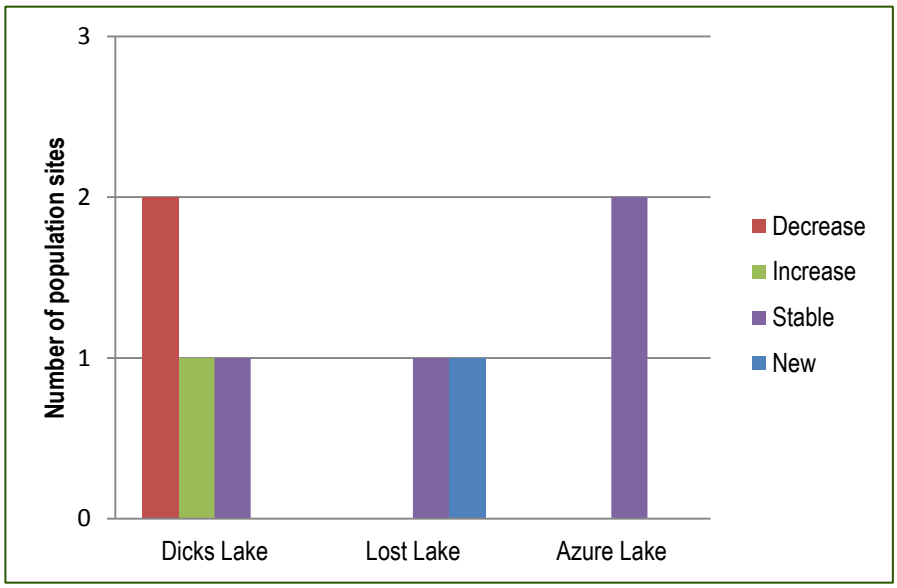
LONG-PETALED LEWISIA
Status: **Considerably Better than Target**
Trend: **Little or No Change**
Confidence: **Moderate**

Map



Approximate locations of two Long-petaled lewisia sites in the Lake Tahoe Basin, September, 2010.

Trend



Number of population sites of Long-petaled lewisia where plant counts decreased, increased, were stable, or where new population sites were detected between 2004 and 2009. Source: U.S. Forest Service-LTBMU

Data Evaluation and Interpretation

Relevance – Long-petaled lewisia *(Lewisia longipetala*) is a low-growing perennial plant in the Purslane (Portulaceae) family. The species has pale pink flowers and fleshy leaves and grows on high elevation peaks (>8,000 feet) in moist, rocky habitats directly below persistent snowfields (Halford and Nowak 1996). The worldwide distribution of long-petaled lewisia is limited to the Sierra Nevada crest in El Dorado, Nevada, and Placer Counties, California (CNPS 2010). Within the Lake Tahoe Basin the species is found in the vicinity of three lakes in the Desolation Wilderness: Dicks Lake, Lost Lake, and Azure Lake (see above map). The current status of the majority of occurrences located outside of the Lake Tahoe Basin is unclear, but it is likely that the greatest number of plants occurs in the Basin populations, and therefore, these populations are critical to the viability of the entire species. Long-petaled lewisia has special designations by TRPA and the U.S. Forest Service that provide the plants with increased levels of protection.
Threshold Category – Vegetation
Indicator Reporting Category – Sensitive Plants
Adopted Standards – Maintain two Long-petaled lewisia population sites.
Type of Standard: Numerical Standard
Indicator (Unit of Measure) – The total number of population sites that are maintained as suitable habitat as determined by a qualified expert.
Attainment Status – Long-petaled lewisia currently exists in the Lake Tahoe Basin in the vicinity of three lakes in the Desolation Wilderness (Engelhardt and Gross 2011a). A combined total of eight population sites exist near these three lakes, indicating a trend determination of "considerably better than target." Therefore, the Threshold Standard is in attainment.
Trend – Quantitative monitoring of long-petaled lewisia in the Basin began in 2004 when plants were located and counted at

six population sites (Engelhardt and Gross 2011c). An additional site was added in 2006. All sites were re-surveyed in 2009. Between 2004/06 and 2009, plant counts at four of the seven populations sites were stable (57%), one increased (14%), and two declined (28%). A new population site in the vicinity of an existing site was also added, bringing the number of tracked population sites in the Tahoe Basin to eight. Recent declines in snowpack may have contributed to the decline of two of the four population sites at Dicks Lake (above figure), but successive years of data will be required to better assess the trend for long-petaled lewisia. Since plant counts at the majority of sites were stable, increased, or were newly identified, and the alpine habitat where long-petaled lewisia occurs is naturally stable, a conservative approach leads to the conclusion that there is "little or no change" in the trend of long-petaled lewisia.

Confidence – There is a high degree of confidence in the status due to the quality of the data collected and the robust nature of the monitoring program. However, there is low confidence in the trend analysis because it was based on data from only two sample periods in 2004/06 and 2009. Therefore, there is a "moderate" level of confidence in the status and trend.

Interim Target – None, the Threshold Standard is in attainment.

Target Attainment Date – None, the Threshold Standard is in attainment.

Human & Environmental Drivers – Human activities that pose direct threats include recreational activities that might trample or uproot plants (e.g., camping, hiking, equestrian use, trail construction, snowmobiles) (Halford 1992). However, the known populations in the Basin are located in remote, off-trail areas; of greater concern is the potential threat of snowpack decline and altered hydrologic regimes related to climate change. Long-petaled lewisia populations are very dependent on water supplied by persistent snowfields, so changes in the timing and quantity of snowmelt associated with climate change have the potential to impact the species (Halford and Nowak 1996). Competitive exclusion could also occur if other plant species gain the ability to expand into habitat that previously supported hydrologic conditions more favorable for long-petaled lewisia (Halford and Nowak 1996).

Monitoring Approach – An extensive survey was conducted for long-petaled lewisia in 1991 and one long-term monitoring plot was installed at a population site occurring in the Basin (Halford 1992). More recently, the U.S. Forest Service initiated a comprehensive monitoring program for the species in 2004 based on similar methods (Engelhardt and Gross 2011c). Long-term monitoring plots were installed at Dicks Lake and Lost Lake, but it was not possible to establish plots at Azure Lake due to the presence of extensive granite slabs that prevented the installation of permanent markers. Plant populations are visited every five years, or more frequently when data suggests the population is decreasing. The monitoring objective is to provide a quantitative and consistent method for evaluating status and trend, especially at sites comprised of large numbers of plants where it is difficult to accurately count individuals. Monitoring at permanent plots allows for more repeatable and efficient surveys.

Monitoring Partners – A long-term monitoring plan was developed and is implemented by ecology and botany staff from the U.S. Forest Service – LTBMU in coordination with Eldorado and Tahoe National Forest staff. Monitoring is being conducted at two locations within the Basin.

Programs and Actions Implemented to Improve Conditions – TRPA has adopted ordinances that require that sensitive plants are protected from adverse activities.

Effectiveness of Programs and Actions – Not Applicable

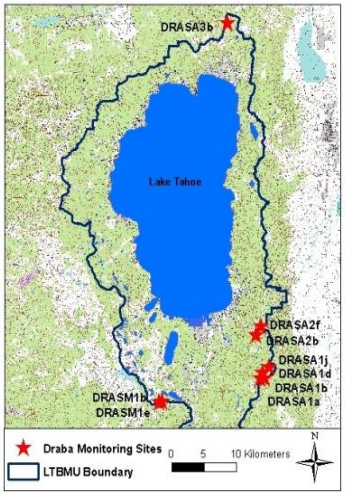
Recommendation for Additional Actions – The current Threshold Standard of two population sites represents only 25% of the eight different population sites where long-petaled lewisia is currently being monitored. The Threshold Standard is insufficient, and lacks conservation relevance because it does not reflect a biological understanding of a plant population. A biological definition of a plant population describes a unit where plants interact and are more closely related with each other than with plants from a different population (NatureServe 2004). A population is generally defined as occurring at least 1 km from another population, and a subpopulation is defined as a discrete occurrence within 1km of other subpopulations (NatureServe 2004). Accordingly, long-petaled lewisia exists in the Tahoe Basin in three populations near three lakes in the Desolation Wilderness. It is recommended that the Threshold Standard be increased to three populations, that each population is comprised of at least two subpopulations, and that at least one of these subpopulations is comprised of a minimum of 1,000 plants. This change would better reflect biologically important populations for conservation, and increase protection of the species in the Tahoe Basin. If these proposed changes were adopted, the status of the species would remain "considerably better than target." It is further recommended that the name of the species is corrected from *Lewisia pygmaea longipetala* to *Lewisia longipetala* because the species is recognized as a distinct taxon and not as a subspecies of *L. pygmaea* (CNPS 2010).

Sensitive Plants: **Cup Lake Draba (*Draba asterophora* var. *macrocarpa*)**

Reporting Icon

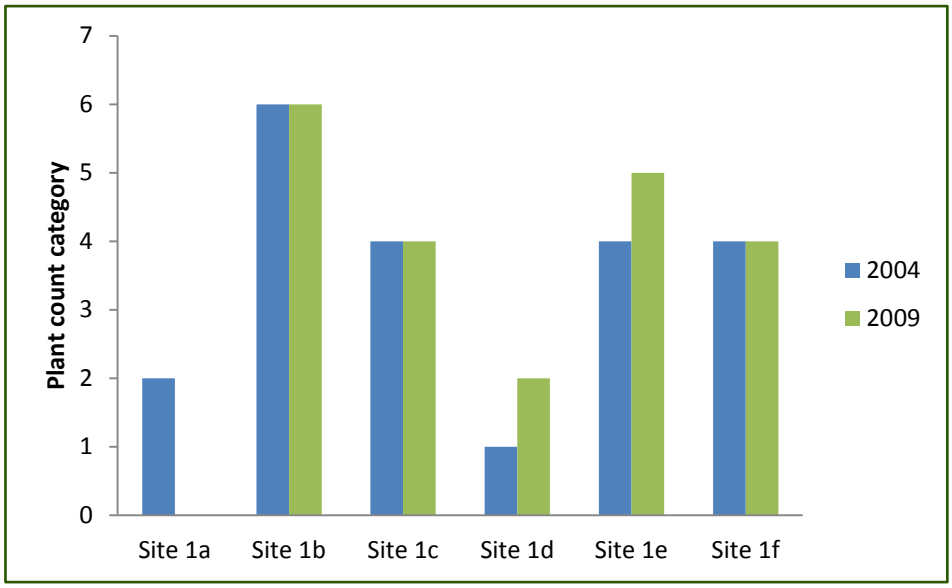
CUP LAKE DRABA
Status: **Considerably Better than Target**
Trend: **Little or No Change**
Confidence: **Moderate**

Map



The two approximate locations of Cup Lake draba (labeled DRASM) in the Lake Tahoe Basin, September, 2010.

Trend



Census results for six Cup Lake draba population sites in 2004 and 2009. The number of plants found in the various plant categories are: 1 = 1-14, 2 = 15-99, 3 = 100-249, 4 = 250-499, 5 = 500-1000, 6 = >1000. Source: U.S. Forest Service-LTBMU.

Data Evaluation and Interpretation

Relevance – Cup Lake draba (*Draba asterophora* var. *macrocarpa)* is a small alpine perennial plant in the Brassicaceae (Mustard) family. The species has small yellow flowers and is characterized by a cushion growth form where all the foliage grows close to the ground in a short mound or mat (Baad 1979). Cup Lake draba is only known to occur at Cup Lake, which is outside of the Basin, and within the Basin on a ridge between Saucer Lake and Ralston Peak (Figure 1). More than half of the known plants occur in the Basin population; thus this population is critical to the viability of the entire species. Cup Lake draba has special designations by TRPA and the U.S. Forest Service who provide the plant with increased levels of protection.
Threshold Category – Vegetation
Indicator Category – Sensitive Plant Species
Adopted Standards – Maintain two Cup Lake draba population sites.
Type of Standard – Numerical Standard
Indicator (Unit of Measure) – The total number of population sites that are maintained as suitable habitat as determined by a qualified expert.
Status –Cup Lake draba currently exists in a total of six population sites in the Basin, which is three times the target of two population sites. Therefore, the Threshold Standard was determined to be "considerably better than target."

Trend – Quantitative monitoring of Cup Lake draba began in 2004 when plants were located and counted at six population sites (Engelhardt and Gross 2011b). All sites were re-surveyed in 2009. Between 2004 and 2009, plant counts at three of the population sites were stable (50%), two increased (33%), and no plants were found at one site (17%) (see above figure). The site where no plants were found (Site 1a) in 2009 occurred in marginal habitat with large amounts of litter. With only one data set it is not possible to know if the site has become unsuitable habitat over the last five years, or if there was just insufficient rainfall/snowpack in 2009 to support plants. With only two years of survey data it is not statistically possible to assess a trend for Cup Lake draba. However, plant counts at 83% of the population sites were stable or increased over the last five years, and the high elevation cushion plant community where Cup Lake draba occurs is known to be naturally stable. This leads to the conclusion that there was "little or no change" in the trend.

Confidence – There is a high degree of confidence in the status based on the quality of the data collected and the robust nature of the monitoring program. However, there is low confidence in the trend determination because the trend analysis is based on data from only two sampling periods in 2004 and 2009. Therefore, there is a "moderate" level of confidence in the status and trend.

Interim Target – None, the Threshold Standard is in attainment.

Target Attainment Date – None, the Threshold Standard is in attainment.

Human & Environmental Drivers – Human activities that pose direct threats include recreational activities that might trample or uproot plants (e.g., camping, hiking, equestrian use, trail construction, snowmobiles) (Englehardt and Gross 2011b). However, the known populations in the Basin are located in remote, off-trail areas, and the greater concern is the potential threat of climate change. Climate change may adversely affect Cup Lake draba populations through its influence on precipitation type, timing, and quantity. Decreased snowpack or a change in snowmelt timing could alter plant community composition and species interactions, and/or decouple plant flowering periods and insect pollinator visitation.

Monitoring Approach – A long-term monitoring program for Cup Lake draba was initiated in 2010 (Engelhardt and Gross 2011b). Plant populations are visited every five years, or more frequently when data suggests the population is decreasing. The monitoring objective is to provide a quantitative and consistent method for evaluating status and trend, especially at sites comprised of large numbers of plants where it is difficult to accurately count individuals. Monitoring at permanent plots allows for more repeatable and efficient surveys.

Monitoring Partners – Ecology and botany staff from the U.S. Forest Service – LTBMU, and Eldorado National Forest has developed, and currently implement, a long-term monitoring plan for the species.

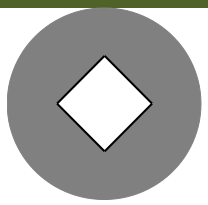
Programs and Actions Implemented to Improve Conditions – None.

Effectiveness of Programs and Actions – Not Applicable

Recommendation for Additional Actions – The current Threshold Standard of two "population sites" represents only 33% of the six different population sites where Cup Lake draba is currently being monitored. More importantly, the standard lacks conservation relevance because it does not reflect a biological understanding of a plant population. A biological definition of a plant population describes a unit where plants within the unit interact and are more closely related with each other, than with plants from a different population (NatureServe 2004). A population is generally defined as occurring at least 1 km from another population, and a subpopulation is defined as a discrete occurrence within 1 km of other subpopulations. According to this definition, Cup Lake draba occurs in only two populations, at Saucer Lake and Cup Lake. However, because Cup Lake is outside of the Tahoe Basin, it cannot be included in the Threshold Standard. It is recommended that the Threshold Standard be changed to one population comprised of at least four subpopulation sites, and that at least one of these subpopulations has a minimum of 1,000 plants. This change essentially doubles the standard of protection for the population at Saucer Lake by ensuring that at least four of the subpopulations that were stable or increased over the last survey period are specifically protected. If this change were adopted, the current and near-term status of Cup Lake draba would remain "considerably better than target."

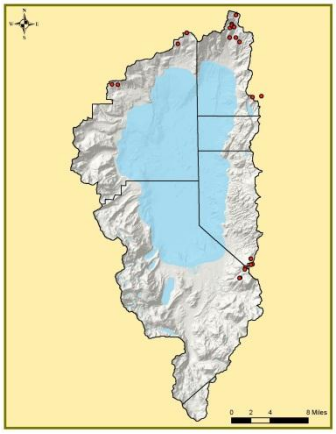
Sensitive Plants: **Galena Creek Rockcress (*Arabis rigidissima* var. *demota*)**

Reporting Icon



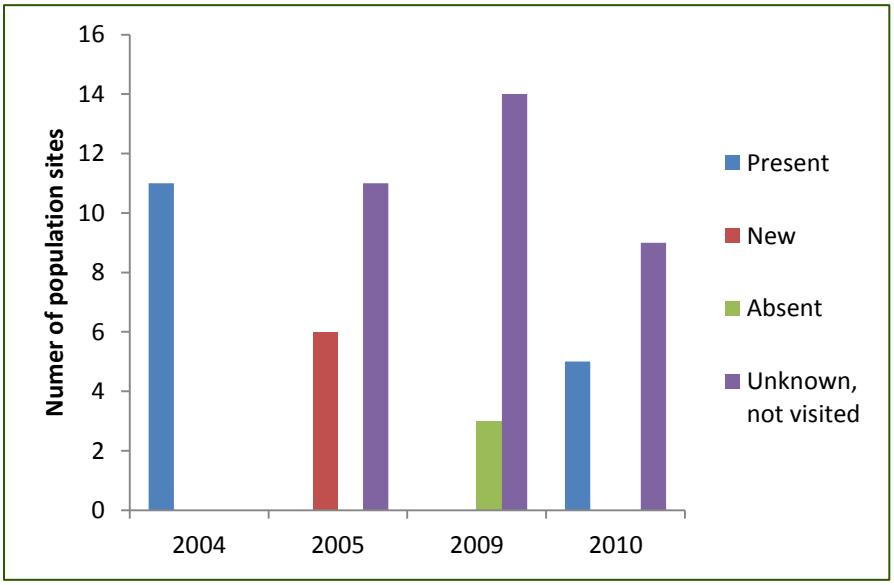
GALENA CREEK ROCKCRESS
Status: **Unknown**
Trend: **Unknown**
Confidence: **N/A**

Map



Approximate locations of suspected Galena Creek rockcress in the Lake Tahoe Basin, September, 2010. Source: USFS-LTBMU

Trend



Number of population sites of Galena Creek rockcress where plants were present, absent, or where new population sites were detected between 2004 and 2009. Source: U.S. Forest Service-LTBMU.

Data Evaluation and Interpretation

Relevance – Galena Creek rockcress (*Arabis rigidissima* var. *demota)* is a slender perennial plant in the Brassicaceae (Mustard) family. The species has small white flowers and occurs in forest openings above 7,000 feet on moderate to steep slopes, often in drainage ways, near meadow edges, or in other moisture-accumulating microsites (Tiehm 1989). The species was first described in 1983, but it is very difficult to identify, and it appears to be hybridizing with the common Pioneer rockcress (*Arabis platysperma)* (Rollins 1983; Rollins 1993). The two species are quite similar, and while Galena Creek rockcress is taller, more erect in stature, and has more slender fruits than Pioneer rockcress, consistently distinguishing between these species and the hybrid is problematic (Engelhardt and Gross 2011a). Galena Creek rockcress has been found in the Tahoe Basin near Martis Peak and Incline Lake in the north, and near Monument Peak in the south (see map above). However, Pioneer rockcress is also very common in these areas, and hybridization appears to be an increasing problem. Galena Creek rockcress was first recommended for inclusion TRPA listed sensitive plant species in the 2001 Threshold Evaluation, based on the fact that it was identified as a focal species in the Lake Tahoe Watershed Assessment, and the U.S. Forest Service had listed it as a Species of Concern (Murphy and Knopp 2000; TRPA 2001). However, TRPA staff declined to evaluate the species in the 2006 Threshold Evaluation, citing concerns over the validity of the species, and a lack of information (TRPA 2007c). The species is on list 1B.2 of the California Native Plant Society, meaning it is "fairly endangered in California" (CNPS 2010), but the species is not recognized in the current edition of the Jepson Manual, the foremost authority on California flora (Hickman 1993; JEPSON 2011).

Threshold Category – Vegetation

Indicator Reporting Category – Sensitive Plant Species

Adopted Standards – Maintain seven Galena Creek rockcress population sites
Type of Standard – Numerical Standard
Indicator (Unit of Measure) – The total number of population sites that are maintained as suitable habitat as determined by a qualified expert.
Status – Presence/absence data is the most reliable type of data that may be collected for this species due to the difficulties with identification. In the first year of monitoring in 2004, Galena Creek rockcress was present, but the identity as Galena Creek rockcress was unconfirmed at 11 population sites (see above figure). In the following year, six new sites were added, also unconfirmed. Surveys were not conducted again until 2009, when no plants were observed at three population sites near Monument Peak. In 2010, specimens of Galena Creek rockcress were collected at five population sites (three near Incline Lake, and two near Martis Peak), and the status was unknown at the other nine population sites. The identity of specimens from the five population sites has not been confirmed by an expert and therefore, there was insufficient information to assess threshold attainment. Because of the uncertainty associated with the identification of the species, the current status was determined to be "unknown."
Trend – As of 2010, surveys conducted by the U.S. Forest Service have identified Galena Creek rockcress at 14 potential population sites (Engelhardt and Gross 2011a). Of these 14 sites, the identity of collected specimens from five population sites near Martis Peak and Incline Lake need to be confirmed by an expert, and the status of nine population sites near Monument Peak is currently "unknown." Therefore, it was not possible to determine a trend due to insufficient data.
Confidence – Because of uncertainty associated with status and trend (due to the difficulties associated with species identification and the incompleteness of the surveys), determination for confidence is "not applicable" (N/A).
Interim Target – Galena Creek rockcress was first described as a distinct species based on measureable characteristics of the flowers and fruit (Rollins 1983). In a systematic survey of known populations in 1989, the material showed evidence of hybridization between Galena Creek rockcress and Pioneer rockcress, but both species were also present in "more or less pure form" (Tiehm 1989). In the intervening period it has become more problematic to consistently locate pure forms of Galena Creek rockcress, and genetic research is warranted to determine the type of hybridization that may be occurring, and clarify the taxonomic confusion.
Target Attainment Date – Without genetic research, there is insufficient information to determine the presence and extent of the species, or to project a date for attainment of the Threshold Standard. Currently, there is a lack of funding and interest on the part of qualified researchers to conduct a genetic analysis for the species. However, the U.S. Forest Service is obligated to conduct periodic surveys for Sensitive Species (including Galena Creek rockcress), so any collected specimens could be made available to interested genetic researchers.
Human & Environmental Drivers – Human activities that pose direct threats include recreational activities that might trample or uproot plants (e.g., camping, hiking, equestrian use, trail construction, snowmobiles). The Galena Creek rockcress population sites in the Monument Peak area occur within Heavenly Ski Resort, where construction and maintenance of ski facilities have the potential to directly impact entire population sites (Engelhardt and Gross 2011a). As with other high elevation species, changes in precipitation type, timing, and quantity associated with climate change may adversely affect the species by altering plant community composition and species interactions, and/or decoupling plant flowering periods and insect pollinator visitation.
Monitoring Approach – This species is included in the Sensitive Species Monitoring Program at the U.S. Forest Service - LTBMU. Plant population sites are visited every five years or more frequently when the occurrence is new or data suggests that the population is decreasing.
Monitoring Partners – Monitoring is conducted by botany staff from the U.S. Forest Service – LTBMU.
Programs and Actions Implemented to Improve Conditions – TRPA has adopted "survey and protect" regulations to protect listed rare plants.
Effectiveness of Programs and Actions – Although the species status is unknown, it is believed that requiring surveys and avoidance measures prior to the implementation of actions known to impact sensitive species, is effective at avoiding impacts to sensitive plants.
Recommendation for Additional Actions – The current Threshold Standard of seven population sites represents only 50% of the 14 different population sites where Galena Creek rockcress is currently being monitored. However, genetic research should be conducted to determine the type of hybridization that may be occurring between Galena Creek rockcress and Pioneer rockcress, and clarify the taxonomic confusion between the two species. If the taxon turns out to be valid, all population sites need to be re-surveyed and the identity confirmed by an expert. The Threshold Standard should then be revised to reflect a biological understanding of a plant population. A biological definition of a plant population describes a unit where plants within the unit interact and are more closely related with each other, than with plants from a different population, generally occurring at least 1 km from other populations (NatureServe 2004). According to this definition, Galena Creek rockcress may presently occur as five populations; one at Incline Lake, one at Martis Peak, and three populations near Heavenly Ski Resort.